EPA/ROD/R03-99/062
1999

EPA Superfund
Record of Decision:

NAVAL SURFACE WARFARE CENTER - DAHLGREN
EPA ID: VA7170024684
OU 09
DAHLGREN, VA
09/27/1999

SITE 25 - PESTICIDE RINSE AREA

NAVAL SURFACE WARFARE CENTER
DAHLGREN SITE
DAHLGREN, VIRGINIA

RECORD OF DECISION

SEPTEMBER 1999

TABLE OF CONTENTS

APPENDICES

TABLES

FIGURES

1.0 THE DECLARATION

1.1 SITE NAME AND LOCATION

Site 25 Pesticide Rinse Area
Naval Surface Warfare Center
Dahlgren, Virginia

1.2 STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected remedial action for Site 25 Pesticide Rinse Area at the Naval Surface Warfare Center, Dahlgren Site (NSWCDL) Dahlgren, Virginia. This determination has been made in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by Superfund Amendments and Reauthorization Act of 1986 (SARA), and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on the administrative record for this site.

The Commonwealth of Virginia concurs with the selected remedy (see Appendix A).

ASSESSMENT OF THE SITE

The response action selected in this Record of Decision (ROD) is necessary to protect the public health, welfare, or the environment from actual or threatened releases of hazardous substances into the environment.

1.3 DESCRIPTION OF THE SELECTED REMEDY

Site 25 is one of many sites identified in the Federal Facility Agreement (FFA) for NSWCDL. In previous years, RODs have been issued for several other sites in accordance with the priorities established in the Site Management Plan (SMP).

For Site 25, the selected remedy, Alternative 3, consists of excavation and off-site disposal of contaminated soils and fits the Navy strategy to reduce risks at all NSWCDL sites with minimal long-term care. The remedial action selected in this ROD addresses contamination associated with Site 25 pesticide rinse contents, surface soils, subsurface soils and sediments. The selected remedy for Site 25 is: excavation and off-site disposal of all soil contaminated with pesticides and inorganics at levels exceeding Remedial Acton Objectives (RAOs), in order to protect potential ecological and human receptors. The excavated areas will be backfilled and revegetated and the wetlands restored. The RAOs for the Chemicals of Concerns (COCs) are as follows:

Human Health	
COC	Concentration
Dieldrin	0.67 mg/kg
Antimony	18.0 mg/kg
Ecological	
COC	Concentration
4,4'-DDT-R	1.0 mg/kg
Dieldrin-R	1.0 mg/kg
Antimony	5.0 mg/kg
Lead	50 mg/kg
Mercury	0.10 mg/kg
Silver	2.0 mg/kg

The major components of the selected remedy are as follows:

- French Drain and Contaminated Soil Removal: Excavation of approximately 370 cubic yards of soil covering an area of approximately 2,500 square 6W to a depth of 4 feet below ground surface (bgs) in and around the French Drain at Site 25.

- Excavation of Contaminated Soil in the Source Area Exceeding the RAOs: Excavation of approximately 9,200 cubic yards of soil covering an area of approximately 122,000 square feet to a depth varying from 2 to 4.5 feet bgs.

- Off-site Disposal of Me contaminated soil : Disposal of approximately 9,570 cubic yards of soil by direct landfilling at an offsite facility.

- Site Restoration: The excavated area in and around the French Drain will be backfilled to previous grade and a vegetative cover will be placed on the surface. The excavated area in the wetland where soil exceeding RAOs were present, will be regraded, backfilled, and revegetated to ft extent necessary to reestablish and, if possible, enhance the wetland area. Additional wetlands mitigation may be required.

1.4 STATUTORY DETERMINATIONS

The selected remedy for Site 25 is protective of human health and the environment complies withFederal and Commonwealth of Virginia requirements that are applicable or relevant and appropriate to the remedial action, is cost effective, and utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable.

Based on the nature of the contamination at Site 25, the Navy concluded that it was impracticable to treat the chemicals of concern (COCs) in a cost effective manner. Thus, the selected remedy for this site does not satisfy the statutory preference for treatment as a principal element of the remedy.

A 5-year review will not be required because constituents remaining onsite after remedy implementation are at levels that do not require use restrictions.

1.5 ROD DATA CERTIFICATION CHECKLIST

The following information is included in the Decision Summary section of this ROD. Additional information can be found in the Administrative Record for Site 25.

- Chemicals of concern (COCs) and their respective concentrations
- Baseline risk represented by the COCS
- Cleanup levels established for COCs and the basis for the levels
- Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of groundwater used in the baseline risk assessment and ROD
- Potential land and groundwater use that will be available at the site as a result of the selected remedy.
- Estimated capital, operation and maintenance (O&M), and total present worth costs; discount rate; and the number of years over which the remedy cost estimates are projected
- Decisive factors that led to selecting the remedy (i.e., how the Selected Remedy provides the best balance of tradeoffs with respect to the balancing and modifying criteria)

CAPT. Vaughn E. Mahaffey, USN
Commanding Officer
Naval Surface Warfare Center
Dahlgren, Virginia

24 Sep 99
Date

Abraham Ferdas, Director
Hazardous Site Cleanup Division
U.S. EPA - Region III

9/27/99
Date

2.0 DECISION SUMMARY

2.1 SITE NAME, LOCATION, AND DESCRIPTION

This ROD is issued to describe the Department of the Navy's (NAVY) selected remedial action for Site 25, Pesticide Rinse Area, at the NSWCDL, Dahlgren, Virginia (Figure 2-1). Site 25 is one of several Installation Restoration (IR) sites (Figure 2-2) located at the NSWCDL facility.

Site 25, the Pesticide Rinse Area, is an inactive site located in the southern portion of NSWCDL, approximately 700 feet northwest of Upper Machodoc Creek (Figure 2-3). Access to the site is from Tisdale Road, which lines the western boundary of the site in conjunction with the northeast-southwest trending railroad tracks. A cooling pond is located to the northwest of the site. Several buildings located to the north of Site 25 are occupied by the Public Works Department and the NSWCDL treatment plant is located in the northeastern portion of the site. Site 25 is bounded on the east and south by Upper Machodoc Creek.

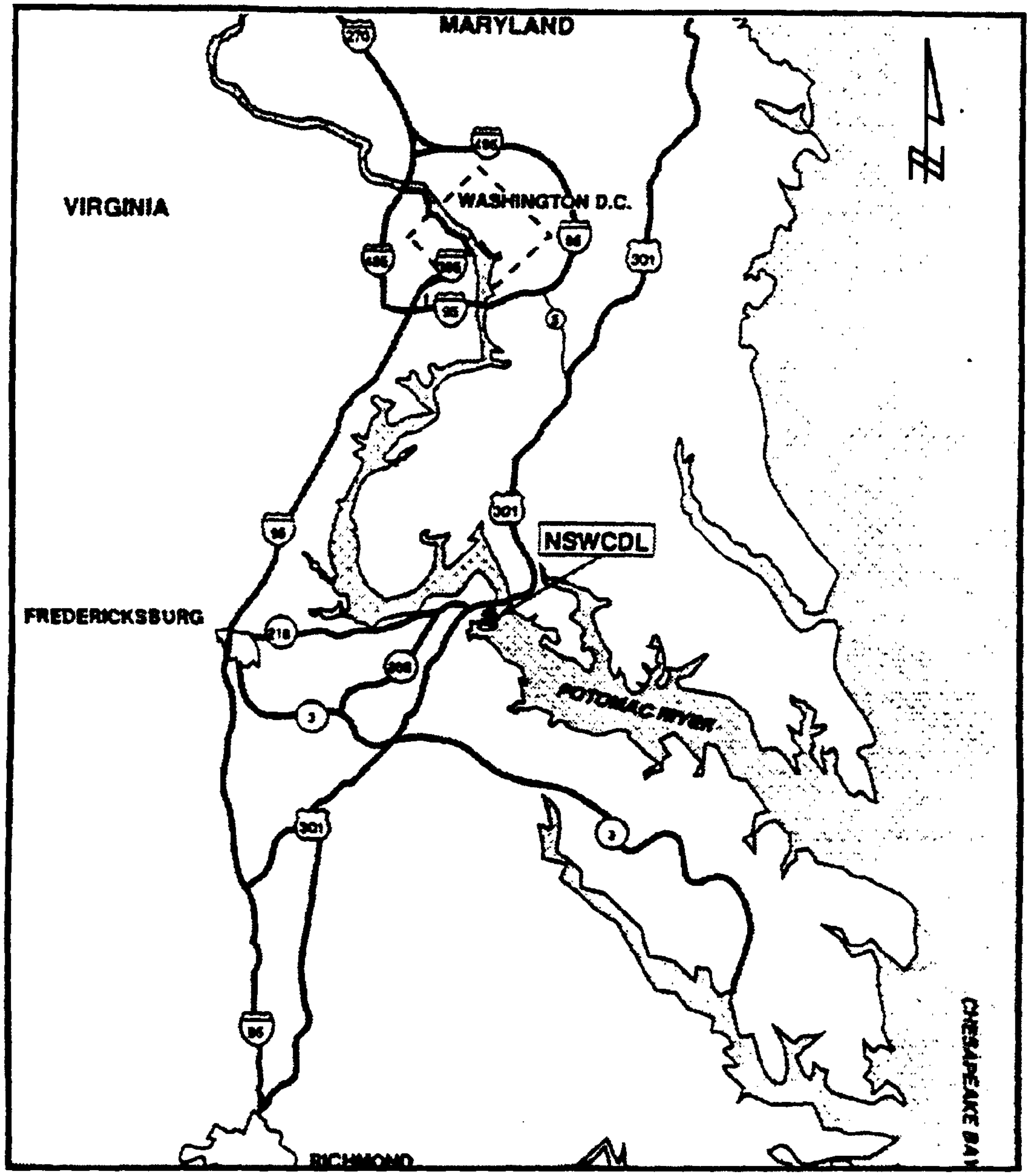
The ground surface at Site 25 includes pavement, gravel cover, and grass. A broad swale downslope of the former location of Building 946 is located in the southern portion of the site. The swale is covered in tall grass, reeds, and related marsh-type plants. The center of the swale is less than 5 feet in elevation and slopes are gentle in the area, typically less than 5 percent. Surface drainage at Site 25 is toward the swale, which flows eastward into Upper Machodoc Creek.

Historic information indicates that past practices at Site 25, which included the rinsing of pesticide containers with wash water, resulted in two areas of concern: (1) the surface drainage swale in the southern portion of the site that received surface runoff from the gravel area near the former location of Building 946; and (2) an area west of Building 134, the location of the former French Drain. The French Drain consisted of a pipe, placed 18 inches bgs, that transported rinse waters from a slop sink in Building 134 to a dry well outside of the building. The dry well was constructed by excavating and gravel filling a 4-foot-square area to a depth of 4 feet

2.2 SITE HISTORY AND ENFORCEMENT ACTIVITIES

2.2.1 <u>History of Site Activities</u>

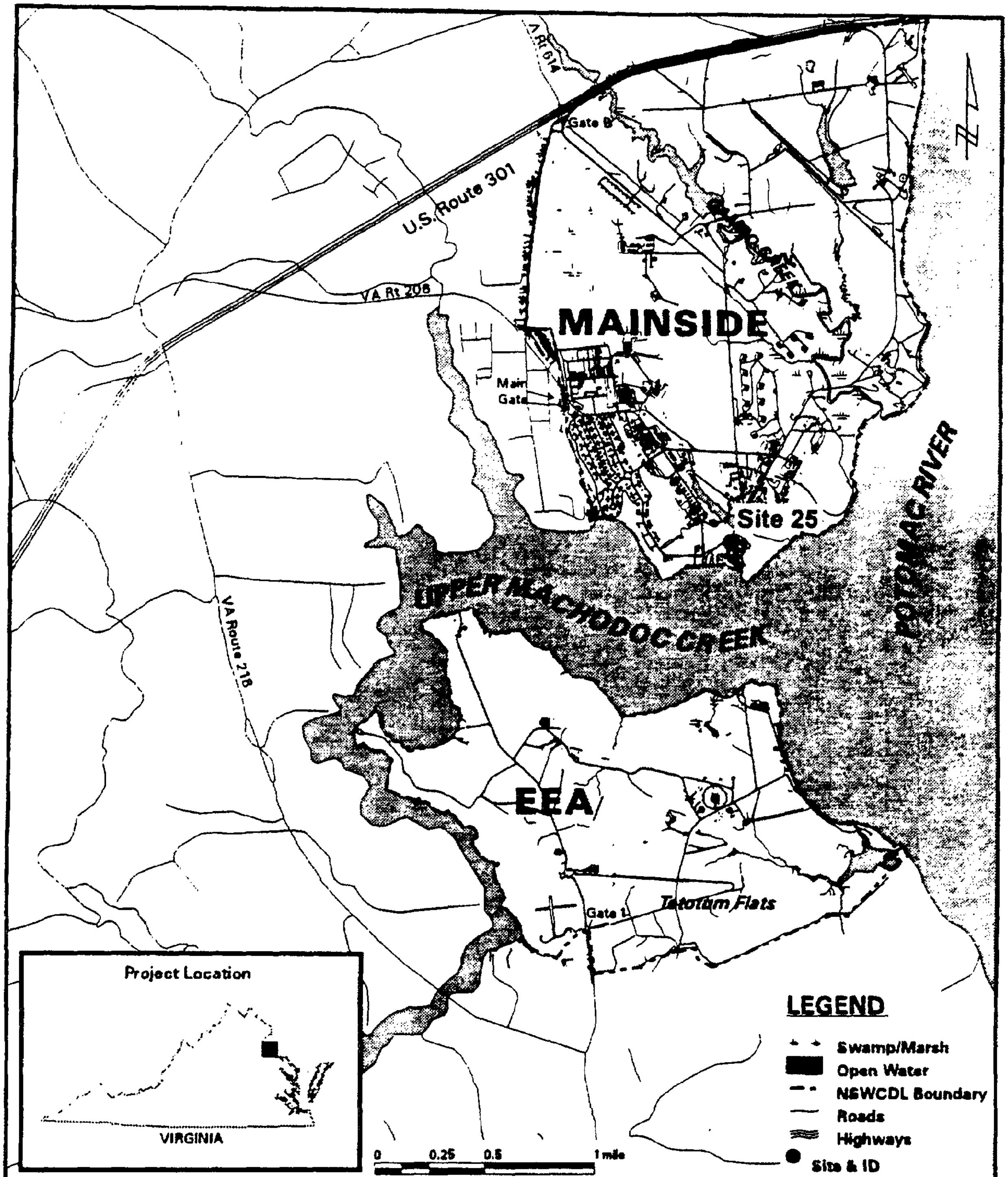
The Pesticide Rinse Area, Site 25, was used during the 1960's and 1970's for calibration of pesticide application equipment and rinsing of empty pesticide containers. The french drain area received washwater from a slop sink located inside Building 134, the former Pesticide Shop. Discharges included



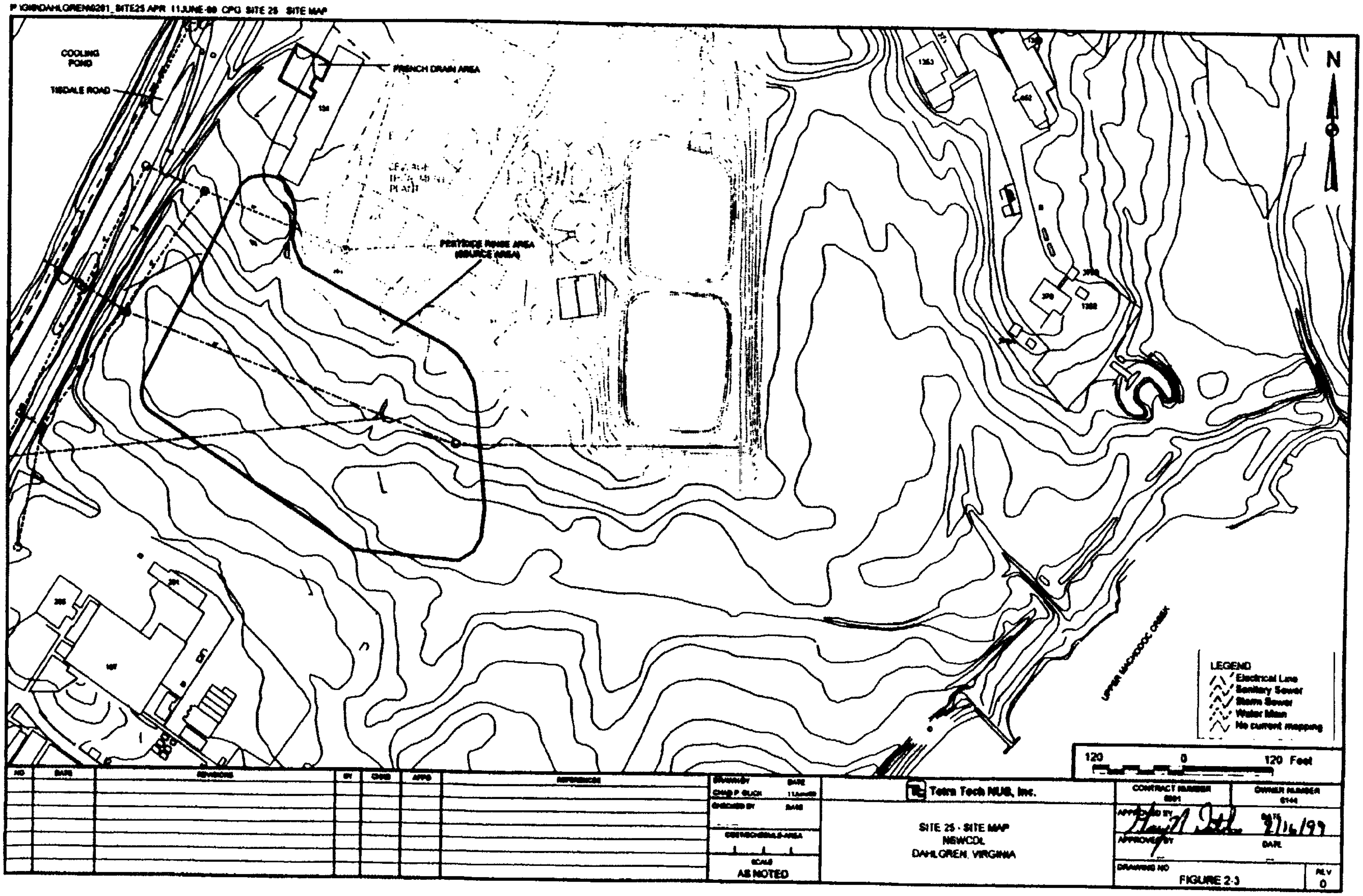
Source: NAVFAC, 1993

DRAWN BY TF / DATE June 99	Tetra Tech NUS, Inc.	CONTRACT NO. 0291	OWNER NO. CTO 0144
CHECKED BY GD / DATE June 99	LOCATION MAP	APPROVED BY / DATE 9/16/99	
COST/SCHED-AREA		APPROVED BY / DATE	
0 10 20 Scale in Miles	NSWCDL DAHLGREN, VIRGINIA	DRAWING NO. Figure 2-1	REV. 0

P:/Dahlgren/Site 17/Pmts/location-0701.cdr



DRAWN BY TF	DATE June 99	Tetra Tech NUS, Inc.	CONTRACT NO. 0291	OWNER NO. CTO 0144
CHECKED BY GD	DATE June 99	SITE LOCATION MAP Site 25	APPROVED BY	DATE 9/16/99
COST/SCHED-AREA			APPROVED BY	DATE
SCALE AS SHOWN		NSWCDL DAHLGREN, VIRGINIA	DRAWING NO. Figure 2-2	REV. 0



COOLING POND
TISDALE ROAD
FRENCH DRAIN AREA
PESTICIDE RINSE AREA (SOURCE AREA)
UPPER MACHODOC CREEK
N
LEGEND
Electrical Line
Sanitary Sewer
Storm Sewer
Water Main
No current mapping
120 0 120 Feet
Tetra Tech NUS, Inc.
SITE 25 - SITE MAP
NSWCDL
DAHLGREN, VIRGINIA
SCALE
AS NOTED
CONTRACT NUMBER
OWNER NUMBER
APPROVED BY
APPROVED BY
DATE
DRAWING NO
FIGURE 2-3
REV
0

pesticide residuals resulting from mixing of pesticides in the sink. Operations ceased during the late 1970's.

According to an U.S. Environmental Protection Agency (U.S. EPA) study of aerial photographs, a former inlet located in the vicinity of the present swale location was filled during the late 1930s to mid-1940s, and buildings, roads, and yard areas were constructed. Additional fill operations were also taking place in the inlets east of the site and along a drainage route southeast of the site. Linear ground scars were identified south of Building 134 with one scar leading to an east-flowing channel. A dark-toned plume, located where the east-flowing channel met the Upper Machodoc Creek, was noted in the 1943 imagery.

By 1952 a delta had developed in the river below the inlets. Aerial photographs between 1952 and 1974 indicated that the ground surface at Site 25 had been modified several times: the area south of Building 134 was graded in 1953; disturbed ground, located along an access road that led through the southern drainage area, was identified in the 1958 imagery; and a channel leading from the southwest comer of Building 134 to the disturbed area was observed in the 1962 imagery. Ground stains were noted on the south side of Building 134 in both the 1952 and 1962 imagery.

The channel leading from the southwest comer of Building 134 was no longer visible in the 1983 imagery; however, evidence of an area of standing liquid and a trench were identified near its former location. Evidence of a stain on the south side of Building 134 was also noted. In 1990 photographs, rectangular objects, and equipment were being stored south of Building 134. A liquid discharge was noted where the stain was identified in 1983. The trench evident in the 1983 imagery was still visible in the 1990 imagery.

2.2.2 Previous Investigations

The first investigation at Site 25 was the Initial Assessment Study (IAS) that began in 1981. The IAS included an on-site records review, site visit and personnel interviews. The IAS concluded that, although the amounts of rinse water used at Site 26 were relatively small and dilute, the hazardous nature of some pesticides warranted a Confirmation Study of soil in the suspect area.

The objective of the Site 25 Confirmation Study, which was conducted in 1983 and 1984, was to determine pesticide concentrations in the soil and any lateral or downward migration of contaminants at the site. This study determined that two distinct areas of concern were at this site. One area was near the French Drain west of Building 134 into which a slop sink in Building 134 drained. The second area was in the vicinity of the swale, which occupies the former inlet/marsh area south of Building 946, where facility personnel indicated that pesticide containers had been drained. The Confirmation Study consisted of soil sampling at the areas of concern in 1983 and an expanded soil sampling effort the following year. The installation and sampling of four groundwater monitoring wells also took place in 1984. In summary, the soil analyses from this study confirmed the presence of pesticides west and south of Building 134 and near Building 946. The pesticides included 4,4'-DDT, 4,4'-DDD, 4,4'-DDE, dieldrin, aldrin, and endrin. One of the four groundwater wells sampled was also found to contain 4,4'-DDT, 4,4'-DDD, and 4,4'-DDE.

2.2.3 Enforcement Actions

No enforcement actions have been taken at Site 25. The Navy has owned the property since the early 1900s and is identified as the responsible party. NSWCDL was added to the National Priorities List (NPL) in 1992. The NPL is a list of the most contaminated hazardous waste sites in the United States.

2.2.4 Highlights of Community Participation

In accordance with Section 113 and 117 of CERCLA, the Navy provided a public comment period from July 21, 1999 through August 19, 1999 for the proposed remedial action described in the Feasibility Study (FS) and the Proposed Plan for Site 25.

These documents were available to the public in the Administrative Record and information repositories maintained at the Smoot Memorial Library, King George, Virginia; the NSWCDL General Library, Dahlgren, Virginia; and the NSWCDL Public Record Room, Oahlgren, Virginia. Public notice was provided in *The Freelance Star* newspaper on July 19, 1999 and *The Journal* newspaper on July 14, 1999 and a public meeting was held in the King George Courthouse on July 28, 1999. No written comments were received during the comment period. Spoken comments and responses provided during the public meeting are presented in Appendix B. Additional community involvement including Restoration Advisory Board (RAB) activities, are detailed in Section 3.1.

2.3 SCOPE AND ROLE OF RESPONSE ACTION FOR SITE 25

Site 25 is one of many sites identified in the Federal Facility Agreement (FFA) for NSWCDL. In previous years, RODs have been issued for several other sites in accordance with the priorities established in the Site Management Plan (SMP).

Past pesticide rinsing operations at Site 25 have contaminated the soil and sediment with pesticides including aldrin, DDT, and dieldrin. The remedial actions identified in this ROD address contamination associated with Site 25, Pesticide Rinse Area, as identified in the Draft Final Remedial Investigation (RI) Report, the Addendum RI Report, and the FS Report for Site 25. Several alternatives for response actions for contaminated media are described In Section 2.6. The rationale for selecting one of those alternatives as the remedy for Site 25 is described in Section 2.7.

The selected remedy is to excavate contaminated surface and subsurface soils at Site 25 in both the French Drain area and the area south of the former location of Building 946. The excavated materials would then be disposed off site at an appropriate RCRA disposal facility. The selected remedy will reduce the potential risk to ecological receptors associated with pesticides (4,4'-DDT, dieldrin) and metals (antimony, lead, mercury, silver) present in surface soils and wetland sediments at the site. The selected remedy will also reduce the potential risk to human receptors from pesticides (dieldrin) and metals (antimony) in surface soil and metals in subsurface soil at the site. Finally, the selected remedy will reduce the risks from metals in surface and subsurface soils migrating to the groundwater and the nearby Upper Machodoc Creek.

The remedy is consistent with long-term remedial goals for Site 25. The remedial action will reduce risks to human and ecological receptors in the wetland and Upper Machodoc Creek from soil and sediment contamination.

2.4 SITE CHARACTERISTICS

The Pesticide Rinse Area is located in the southern portion of the Mainside, approximately 700 feet northwest of the Upper Machodoc Creek. Access to the site is from Tisdale Road, which lines the western boundary of the site in conjunction with the railroad tracks. The cooling pond is located to the northwest of the site. The NSWCDL sewage treatment plant is located to the northeast of the site. Site 25 is bounded on the east and south by Upper Machodoc Creek. The ground surface at Site 25 includes pavement gravel cover, and grass. A broad swale is located in the southern portion of the site. The swale is covered in tall grass, reeds, and related marsh-type plants. Maximum elevations of 15 feet occur near the railroad tracks, a portion of which is on an embankment. The center of the swale is less than 5 feet in elevation. Slopes are gentle in the area, typically less than 5 percent. Surface drainage at the site is toward the swale, which flows eastward into Upper Machodoc Creek and eventually to the Potomac River.

The RI at Site 25 was completed in phases and included a contamination assessment and a risk assessment. The initial RI field investigation, performed in 1994, was developed as a result of earlier investigations to determine the limits of contamination (both areal and vertical) at the site. To accomplish this many of the surface soil and subsurface soil samples collected during this investigation were outside the main areas of known contamination where the confirmation study samples had been previously collected. Groundwater samples were also collected from six shallow wells in the vicinity of the site to determine the potential for site contaminants to migrate into the surficial aquifer. Finally, three surface water and associated sediment samples were collected from the drainage swale to evaluate potential contaminant transport and environmental impacts. In addition to the organochlorine pesticides analyzed in previous studies, all samples that were collected during the RI field investigation were analyzed for dioxins and furans, TAL metals, TCL volatile and semivolatile organics, and other pesticides/herbicides previously used at NSWCDL. Additional sampling of one groundwater monitoring well was completed in 1996 to verify that the presence of pesticides in previously tested groundwater was attributable to particulates present in the sample. In 1998, additional surface and subsurface soil samples were collected at the site. Sampling efforts concentrated on the areas of heaviest suspected contamination as well as those outlying areas for which no date was previously available. Another round of groundwater sampling was also performed at four wells.

2.4.1 Sources of Contamination

The only known source of contamination at the site is the past practice of disposal of pesticide rinse water to the subsurface through the French Drain or directly to the surface.

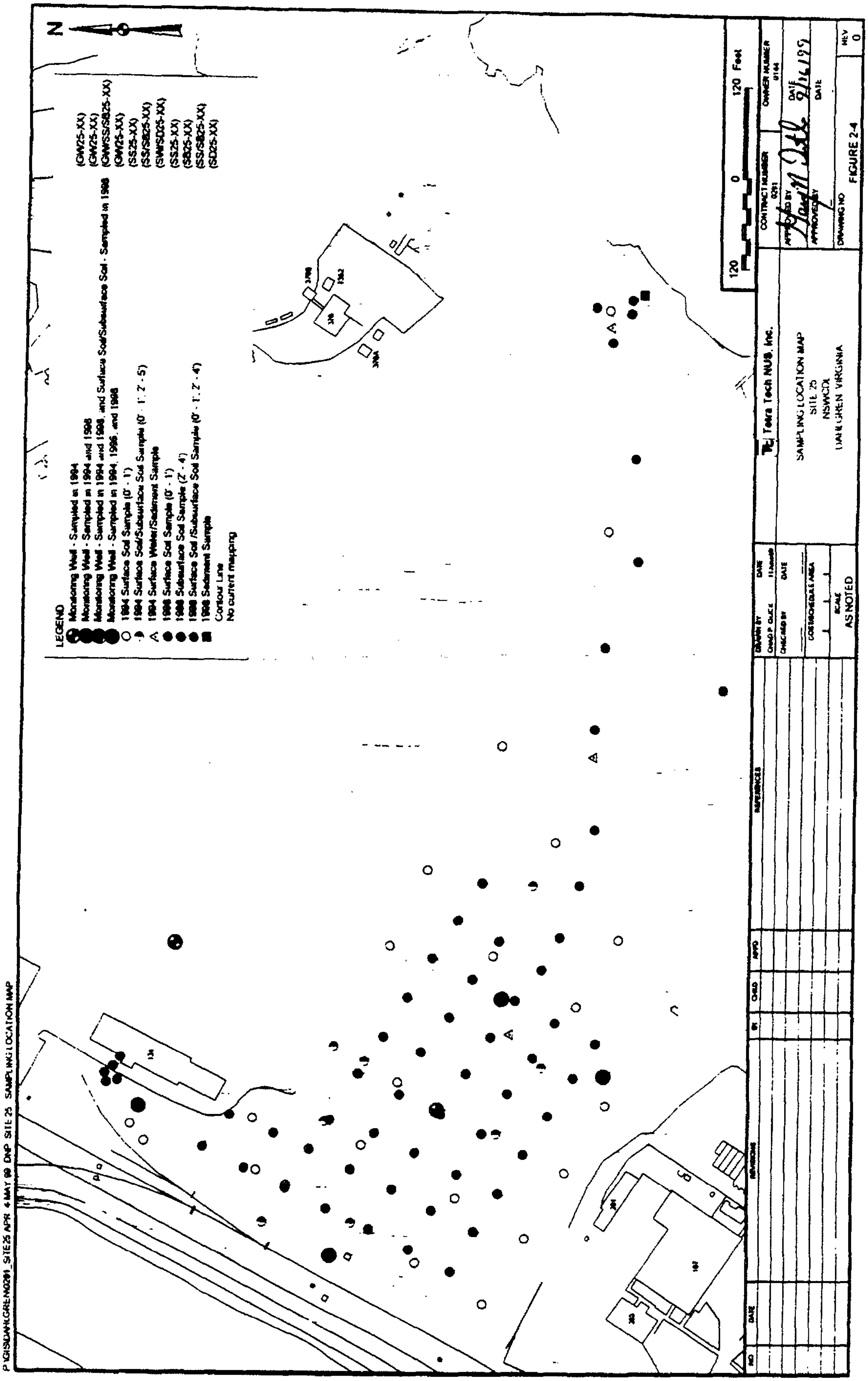
2.4.2 Description of Contamination

Soil, sediment and groundwater samples were collected and analyzed at the locations shown on Figure 2-4. Sediment samples were collected from areas of the drainage swale where localized ponding of water was observed. Because the presence of surface water at these locations is temporary and does not support aquatic biota, the data from the sediment samples were included with the surface soil data.

Surface and Subsurface Soil

The Chemicals of Potential Concern (COPCs) in the surface soil (0 to 2 feet bgs) that contributed the most to the overall risk included pesticides (4,4'-DDT and its breakdown products 4,4'-DDD and 4,4'-DDE, dieldrin, and aldrin,), one inorganic metal (arsenic), one semivolatile compound (benzo(a)pyrene) and four dioxins/furans (1.2,3,4,6,7,8 HPCDF, 1,2,3,4,7,8-HXCDF, 1,2,3, 6,7,8 HXCDF, and OCDF). 4,4'DDT and dieldrin were the pesticides found in the highest concentrations in the surface soils at Site 25 (190,000 µg/kg and 260,000 µg/kg, respectively). Occurring in 90 percent of the samples, 4,4'-DDE and 4,4'-DDT were the most prevalent pesticides found in the surface soils at the site. Metals were detected at concentrations higher than background levels, although no pattern of contamination that could be associated with the potential source area shown in Figure 2-3 was evident. Dioxin and furan detections were scattered and infrequent. Table 2-1 summarizes the COPCs for surface soil and presents their maximum exposure point concentration.

Combining the COPCs for surface and subsurface soil (deeper than 2 feet bgs) adds only one inorganic metal (antimony) to the list of COPCs generated for surface soils. Antimony occurred at a somewhat higher frequency (in approximately 20 percent of the samples) and concentration in the subsurface soil


P:\GIS\DAHLGREN\0281_SITE25.APR 4 MAY 99 DNP SITE 25 SAMPLING LOCATION MAP
N
LEGEND
Monitoring Well - Sampled in 1994 (GW25-XX)
Monitoring Well - Sampled in 1994 and 1998 (GW25-XX)
Monitoring Well - Sampled in 1994 and 1998, and Surface Soil/Subsurface Soil - Sampled in 1998 (GW/SS/SB25-XX)
Monitoring Well - Sampled in 1994, 1996, and 1998 (GW25-XX)
1994 Surface Soil Sample (0' - 1') (SS25-XX)
1994 Surface Soil/Subsurface Soil Sample (0' - 1', 2' - 5') (SS/SB25-XX)
1994 Surface Water/Sediment Sample (SW/SD25-XX)
1998 Surface Soil Sample (0' - 1') (SS25-XX)
1998 Subsurface Soil Sample (2' - 4') (SB25-XX)
1998 Surface Soil /Subsurface Soil Sample (0' - 1', 2' - 4') (SS/SB25-XX)
1998 Sediment Sample (SD25-XX)
Contour Line
No current mapping
120 0 120 Feet
Tetra Tech NUS, Inc.
SAMPLING LOCATION MAP
SITE 25
NSWCDL
DAHLGREN, VIRGINIA
CONTRACT NUMBER
0281
OWNER NUMBER
0144
APPROVED BY
DATE
9/16/99
APPROVED BY
DATE
DRAWING NO.
FIGURE 2-4
REV
0
DRAWN BY
DATE
CHAD P. GLICK
CHECKED BY
DATE
COST/SCHEDULE AREA
SCALE
AS NOTED
NO
DATE
REVISIONS
BY
CHKD
APPD
REFERENCES

This page intentionally left blank

TABLE 2-1

HUMAN HEALTH
CHEMICALS OF POTENTIAL CONCERN AND EXPOSURE POINT CONCENTRATIONS[1]
SITE 25, PESTICIDE RINSE AREA
NSWCDL, DAHLGREN, VIRGINIA

	Organics		Inorganics	
Medium	**Chemical**	**Exposure Point Concentration (mg/kg)[2]**	**Chemical**	**Exposure Point Concentration (mg/kg)[2]**
Surface Soil	Benzo(a)pyrene 4,4'-DDD 4,4'-DDE 4,4'-DDT Aldrin Dieldrin 1,2,3,4,6,7,8-HPCDF 1,2,3,4,7,8-HXCDF 1,2,3,6,7,8-HXCDF OCDF	0.27 7.4 1.3 13 0.18 48 0.00060 0.00014 0.00013 0.0026	Arsenic	8.1
Surface/ Subsurface Soil	Benzo(a)pyrene 4,4'-DDD 4,4'-DDE 4,4'-DDT Aldrin Dieldrin 1,2,3,4,6,7,8-HPCDF 1,2,3,4,7,8-HXCDF 1,2,3,6,7,8-HXCDF OCDF	0.27 7.4 1.3 13 0.18 48 0.00060 0.00014 0.00013 0.0026	Antimony Arsenic	19.6 9.0
Fish Tissue	Not Evaluated[3]	NA	Not Evaluated[3]	NA
Sediment	Not Evaluated[4]	NA	Not Evaluated[4]	NA
Groundwater	Apha-BHC Dieldrin	0.019 0.027	Arsenic Barium Iron Manganese	4.2 443 33,000 5,415

1 95 Percent Upper Confidence Limits (UCLs) on the arithmetic mean were used as exposure point concentrations for the Reasonable Maximum Exposure (RME), and Central Tendency Exposure (CTE) except for groundwater where maximum concentrations were used because the groundwater database contained ten or fewer samples.

2 Exposure point concentrations for groundwater are in µg/L.

3 The small wetland at the site is not large enough to support a population of edible game fish.

4 Human exposure is expected to be minimal because of current/anticipated land use and because of the relatively small size of the wetland area.

NA Not Applicable

compared to the surface soil at the site. However, no pattern of subsurface soil contamination could be associated with a potential source. Table 2-1 summarizes the COPCs for subsurface soil and presents their maximum exposure point concentration.

The presence of pesticides in the surface and subsurface soil at the site is indicative of the previous practice of pesticide rinsewater disposal at the site. The presence of inorganics is expected to be associated with fill material used at Site 25 . The main area of soil contamination associated with the pesticide rinsewater disposal is considered to be within the source area which is outlined in Figure 2-3.

Groundwater

The COPCs identified for groundwater that contributed the most to the overall risk include two pesticides (alpha-BHC and dieldrin) and four inorganic metals (arsenic, barium, iron, and manganese). None of the COPCs exceeded Federal Maximum Contaminant Levels (MCLs) in the 1998 sampling event The most recent round of groundwater samples (from the 1998 sampling event) is used as the basis for the exposure point concentrations presented in Table 2-1.

2.4.3 <u>Contaminant Migration</u>

The presence of a surface water body (Upper Machodoc Creek) approximately 1,000 feet from the source area soil and the potential for migration of pesticides and inorganics via groundwater that eventually discharges to the creek was considered a potential concern. Also, the potential for groundwater toemerge to the surface and carry contaminants to the surface in the vicinity of the source area was also considered a potential concern. To address these two concerns, contaminant fate and transport modeling was performed. The results of the modeling study indicated that because of the low mobility of pesticides and the high attenuation in concentration afforded by mixing with the creek water, none of the pesticides or inorganic contaminants of potential concern would adversely impact either the surface water or sediments in Upper Machodoc Creek. The results of the modeling study also indicated that in the drainage swale area immediately downgradient of the source area soil, there would be minimal potential for contaminants in the groundwater to emerge to the surface and adversely impact ponded water. Details of the modeling were presented in the FS.

2.5 CURRENT AND POTENTIAL FUTURE SITE AND RESOURCE USES

Site 25 is located in the southern portion of the Mainside, approximately 700 feet northwest of Upper Machodoc Creek. The ground surface at Site 25 includes pavement gravel cover, and grass. A broad swale downslope of the former location of Building 946 is located in the southern portion of the site. The swale, consisting of about 10 naturally vegetated acres, is covered in tall grass, reeds, and related marsh-type plants. Wetlands on Site 25 comprise a roughly 100-foot wide swath of land in the center of the swale. Tisdale Road and a set of railroad tracks line the western boundary of the site. A cooling pond is located to the northwest of the site on the other side of Tisdale Road. Several buildings located to the north of Site 25 are occupied by the Public Works Department and the NSWCDL treatment plant is located in the northeastern portion of the site. Site 25 is bounded on the east and south by Upper Machodoc Creek.

Site 25 is within an industrial use area and is anticipated to remain an industrial use area in the future.. The roadside adjacent to Site 25 is mowed and maintained on a regular basis and all activity at the site is limited to the activities in adjacent buildings and roadsides. Recreational activity in this area is limited to jogging along Tisdale Road. Fishing occurs in the cooling pond; however, the pond is not considered to be part of the site. The industrial use of the base is currently expanding and future potential for base closure and conversion to residential land use is considered to be minimal.

The watertable (or Columbia) aquifer beneath Site 25 is a thin water bearing zone underlain by a laterally persistent clay confining layer (or Upper Confining Unit). Shallow groundwater at the Base is known to discharge to adjacent shallow water bodies, in this case Upper Machodoc Creek. The watertable aquifer at the Base is generally of poor quality because of high, naturally occurring concentrations of some metals (i.e. iron and manganese) according to a United States Geological Survey (USGS) study of basewide groundwater quality, Poor water quality, coupled with the thin saturated thickness and locally high percentages of fine grain sediments, effectively diminishes the feasibiIe of using the watertable aquifer as an industrial or potable water source. However, during the risk evaluation for Site 25, the watertable aquifer is considered to be a potential source of potable water.

2.6 SUMMARY OF SITE RISKS

The human health and ecological risks associated with exposure to contaminated media at Site 25 were evaluated in the Addendum RI Report. Although the site will remain in industrial use, a human health risk assessment was also performed on a hypothetical residential use scenario for informational purposes only. Groundwater in the shallow aquifer is not a current source of drinking water and is not expected to be used as one in the future.

2.6.1 Human Health Risks

The baseline human health risk assessment estimates what risks the site poses if no action were taken. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action. This section of the ROD summarizes the results of the baseline risk assessment for this site.

Exposure Pathways and Potentially Exposed Population

Base workers, construction workers, and on-site residents (children and adults) were evaluated in the quantitative risk assessment. Base workers were evaluated for current and future conditions. Construction workers and on-site residents were evaluated for future conditions only. Although the potential for the site to be converted to residential land use is minimal, potential risks to future on-site residents were quantified for purposes of completeness. Construction workers were evaluated for exposure to surface/subsurface soil (0 to 12 feet) while only surface soil (0 to 2 feet) exposure was considered for all other potentially exposed populations. Under the current and future land use scenarios considered at Site 25, the exposure routes were incidental ingestion of soil and dermal contact with soil.

Inhalation of volatile emissions and dust was evaluated qualitatively via a comparison of site data with USEPA Generic Soil Screening Levels (SSLs) for transfers from soil to air. The observed SSL exceedance for dieldrin was not considered to be significant because this chemical was only detected in a few soil samples at concentrations greater than the corresponding SSL.

The potential groundwater exposure route was considered for hypothetical future residents. These residents were assumed to be exposed by ingestion of groundwater, dermal contact with groundwater, and inhalation of volatiles emitted from water while showering.

Exposure Assessment

The COPCs that were evaluated and their maximum exposure point concentrations are presented in Table 2-1. Exposure point concentrations are used to determine potential human health risks.

Toxicity Assessment

The toxicity assessment characterizes the nature and magnitude of potential health effects associated with human exposure to COPCs at a site. Quantitative risk estimates for each COPC and exposure pathways are developed by integrating chemical-specific toxicity factors with estimated chemical intakes discussed in the previous section.

Quantitative risk estimates are calculated using cancer slope factors (CSFs) for COPCs exhibiting carcinogenic effects and reference doses (RfDs) for COPCs exhibiting systemic (noncarcinogenic) effects. A summary of the RfDs and CSFs used in the baseline human health risk assessment is presented in Table 2-2.

TABLE 2-2

DOSE-RESPONSE PARAMETERS
NAVAL SURFACE WARFARE CENTER, DAHLGREN, VIRGINIA

Chemical	RfD Oral[1] (mg/kg/day)	RfD Inhalation[1] (mg/kg/day)	CSF Oral [1] $(mg/day/kg)^{-1}$	CSF Inhalation[1] $(mg/kg/day)^{-1}$	Gastrointestinal Absorption factor	RfD Dermal (mg/kg/day)	CSF Dermal $(mg/kg/day)^{-1}$	Weight of Evidence
Benzo(a)pyrene	NA	NA	7.3E+0	6.1E+0	0.75[2]	NA[3]	NA[3]	B2
Aldrin	3E-5	NA	1.7E+1	1.7E+1	0.50[4]	1.5E-5	3.4E+1	B2
alpha-BHC	NA	NA	6.3E+0	6.3E+0	NA	NA	6.3E+0	D
4,4'-DDD	NA	NA	2.4E-1	NA	0.80[5]	NA	3.0E-1	B2
4,4'-DDE	NA	NA	3.4E-1	NA	0.80[5]	NA	4.25E-1	B2
4,4'-DDT	5E-4	NA	3.4E-1	3.4E-1	0.80[5]	4E-4	4.25E-1	B2
Dieldrin	5E-5	NA	1.6E+1	1.61E+1	0.50[4]	2.5E-5	3.2E+1	B2
HpCDF	NA	NA	1.5E+3[6]	1.5E+3[6]	0.90[7]	NA	1.67E+3	B2
HxCDF	NA	NA	1.5E+4[6]	1.5E+4[6]	0.90[7]	NA	1.67E+4	B2
OCDF	NA	NA	1.5E+2[6]	1.5E+2[6]	NA	NA	1.5E+2	B2
Antimony	4E-4	NA	NA	NA	0.05[8]	2E-5	NA	D
Arsenic	3E-4	NA	1.75E+0	1.51E+1	0.95[9]	2.85E-4	1.84E+0	A - Inhal.
Barium	7E-2	1.43E-4	NA	NA	0.05[8]	3.5E-3	NA	D
Iron	3E-1[11]	NA[12]	NA[12]	NA[12]	NA[12]	3E-1	NA[12]	NA[12]
Manganese	5E-3 (water) 1.4E-1 (food)	1.43E-5	NA	NA	0.03[10]	1.5E-4	NA	D

[1] USEPA, 1994a
[2] ATSDR, 1987a
[3] Not appropriate to consider dermal toxicity (USEPA, 1994b)
[4] ATSDR, 1991i
[5] ATSDR, 1992a
[6] Based on toxicity equivalence factors for 2,3,7,8-TCDD (USEPA, 1989c).
[7] ATSDR, 1987c
[8] Assumed default value (USEPA, 1989a)
[9] ATSDR, 1991a
[10] USEPA, 1984
[11] ATSDR, 1991f
[12] NA - Not available/applicable

CSFs and RfDs developed by USEPA are based on ingestion (oral) or inhalation routes of exposure rather than dermal contact. Therefore, these values reflect administered doses rather than absorbed doses. USEPA guidance on assessment of dermal exposure (USEPA, 1992b) recommends that oral toxicity factors used in dermal risk assessment be adjusted for gastrointestinal absorption efficiency, if such data are available. The dermal RfDs and CSFs adjusted for gastrointestinal absorption are listed in Table 2-2. The dermal toxicity criteria are derived per the methodology presented in Appendix A of the Risk Assessment Guidance for Superfund, Part A (USEPA, 1989). According to USEPA Region III policy, the dermal contact exposure pathways is not evaluated quantitatively for PAHs. Therefore, potential risks from dermal contact exposure to benzo(a)pyrene in soil are not quantified in this risk assessment.

Chromium Toxicity

Chromium was identified as a COPC in subsurface soil at Site 29. Analytical results for this chemical are reported as total chromium. Chromium may be present in different oxidation states. The hexavalent state, which is a less common state of chromium in environmental mixtures, is the most toxic form of chromium. No analyses were performed to distinguish among the specific chromium oxidation states present at the site. For purposes of risk assessment it is assumed conservatively that chromium is present in the hexavalemt state.

Lead Toxicity

The equations and methodology used for the other COPCs cannot be used to evaluate exposure to lead because of the absence of published dose-response parameters for this hazardous substance. Lead was identified as a COPC for groundwater because the maximum detected concentration of lead, 113 µg/L in sample GW-29-2(94), exceeded the 15 µg/L Federal Safe Drinking Water Act (SDWA) Action Level (USEPA, October 1996b).

Exposure to lead in water is typically addressed using the USEPA Integrated Exposure Uptake Biokinetic (IEUBK) Model for lead (USEPA, 1994a) for exposure to small children. This model evaluates exposure to lead in water and/or soil and is designed to estimate blood lead levels based on either default or site-specific input values. The evaluation of lead is discussed below.

Risk Characterization

Excess lifetime cancer risks are determined by multiplying the intake level and the Cancer Slope Factor (CSF). These risks are probabilities that are generally expressed in scientific notation (e.g., 1×10^{-6}). An excess lifetime cancer risk of 1×10^{-6} indicates that, as a plausible upper bound, an individual has a one in one million chance of developing cancer as a result of site-related exposure to a carcinogen over a 70-year lifetime, under the specific exposure conditions at a site.

Potential concern for noncarcinogenic effects of a single contaminant in a single medium (i.e., soil, water, or air) is expressed as the hazard quotient (HQ) (or the ratio of the estimated intake derived from the contaminant concentration in a given medium to the contaminant's reference dose). By adding the HQs for all contaminants within a medium or across all media to which a given population may reasonably be exposed, the Hazard Index (HI) can be generated. The HI provides a useful reference point for gauging the potential significance of multiple contaminant exposures within a single medium or across media.

Current and Future Base Worker. The cumulative noncancer Hl for ingestion of and dermal contact with soils at Site 25 under industrial land use conditions is 4.9, which exceeds unity and indicates potential for adverse health effects. The cumulative ingestion and dermal contact cancer risk is 1.0×10^{-3}, under a "reasonable maximum exposure" (RME) scenario. This exceeds the USEPA's acceptable target risk range of 1×10^{-6} to 1×10^{-4}. Almost all the cancer and non-cancer risks are caused by the presence of dieldrin in surface soils at Site 25.

Future Construction Worker. The cumulative noncancer HI for ingestion of and dermal contact with soils at Site 25 under the RME scenario is 9.5 which exceeds unity and indicates potential for adverse health effects. The cumulative ingestion and dermal contact cancer risk is 1.0×10^{-4} , under the RME scenario, and this is within the USEPA's acceptable target risk range of 1×10^{-6} to 1×10^{-4}. Almost all the cancer and non-cancer risks are caused by the presence of dieldrin in surface soils at Site 25.

Future Resident. The cumulative noncancer HI for ingestion of and dermal contact with soils at Site 25 under the hypothetical residential land use conditions is 45 for the RME which exceeds unity and indicates potential for adverse health effects. This risk is primarily due to the presence of dieldrin, antimony, iron and manganese in surface soils.

The total residential incremental lifetime cancer risk based on cumulative ingestion and dermal contact with soils is 7.3×10^{-3} under a RME scenario and exceeds the acceptable target risk range. Almost all of this risk is caused by the presence of dieldrin in surface soils at Site 25.

The cumulative noncancer HI for exposure to groundwater at Site 25 under the hypothetical residential land use conditions is 26 under the RME scenario. The HI for the RME exceeds 1.0 primarily as a result of the ingestion of arsenic, iron, and manganese in groundwater. The RfD for iron is not based on health effects, but rather on recommended daily allowances for human nutrition. In addition, it is likely that arsenic and manganese concentrations are from naturally occurring conditions that are not site related.

The total residential incremental lifetime cancer risk based on exposure to groundwater at Site 25 is 1.2 x 10^{-4}, which slightly exceeds the USEPA's target risk range. The risk estimate is primarily influenced by the ingestion of arsenic in groundwater. Once again, the arsenic concentrations are likely from naturally occurring conditions that are not site related.

Uncertainty Analysis. The major sources of uncertainty specific to conditions at Site 25 include:

- The assumed dermal absorption rates from soil are a significant contributor to the uncertainties at this site because dermal absorption is the only exposure route that results in risks greater than 1 x 10^{-6}. Without firm default guidance from the USEPA, general ranges presented in the dermal exposure guidance document, default guidance from other regions, and general literature values were used in an attempt to differentiate between the average and RME cases. This adds considerable uncertainty to the risk characterization for dieldrin.

- The evaluation of arsenic as an oral carcinogen is a conservative approach. There is no USEPA approved CSF for arsenic upon oral exposure. Arsenic is not known to cause cancer upon oral exposure, and therefore the risks associated with arsenic may be overstated.

- Some uncertainty is associated with the use of base background concentrations in the COC selection process since site concentrations less than the maximum background concentration were not considered to be attributable to site-related activities. Background samples were collected from USEPA approved locations that are not considered to be affected by base activities. Analytical results for arsenic in surface soil sample SS00-5 (88.9 mg/kg) and for manganese in surface soil sample SS00-3 (629 mg/kg) were eliminated from the background date set because they were considered to be outside the normal range for background.

- An evaluation of a hypothetical future residential land use scenario was added to the baseline human health risk assessment for Site 25 to aid in future risk management decisions. The evaluation of this scenario does not imply that the site is expected to be used for residential development in the foreseeable future. The likelihood of this scenario is minimal because the mission of the base is currently expanding and Site 25 is located within the restricted area at NSWCDL

2.6.2 Ecological Risks

The intent of the baseline ecological risk assessment (ERA) was to characterize potential hazard or risk to plant and animal populations and habitats (ecological receptors). . Welland identifications, terrestrial habitat/wildlife characterization, and habitat mapping were performed in order to characterize the biota and habitats associated with Site 25. Samples for the ERA were collected from surface soils (0 to 2 feet) at the site as well as from surface waters and sediments from areas of the drainage ditch where standing water was present.

Identification of Ecological COCs

Ecological effects quotients (EEQs) were derived for each COPC in all media. An EEQ represents the ratio of the maximum concentration of a contaminant to a conservative or published cleanup criterion that is applicable to a wide variety of ecological receptors. An EEQ equal to or greater than 1.0 indicates a potential risk to ecological receptors. Based on EEQs, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, aldrin, dieldrin, endrin, endrin ketone, endrin aldehyde, HPCDD, HPCDF, antimony, arsenic, lead, mercury, silver, and zinc in surface soil and sediments, and dieldrin and zinc in surface waters, were identified as COCs for ecological receptors.

Exposure Assessment

Potential ecological receptors at Site 25 are terrestrial receptors such as rabbits, meadow voles, mice, earthworms, ground insects, and a variety of birds. Direct contact with contaminated soil, incidental ingestion of contaminated food, and incidental ingestion of contaminated soil are the primary pathways of exposure to terrestrial receptors at this site. Exposure to contaminated subsurface soil is unlikely under current or reasonably anticipated future site conditions. Exposure to surface water or sediment is a less likely pathway of exposure because of the intermittent nature of the presence of surface water and associated sediment.

Ecological Effects Assessment

The toxicity of the Site 25 soil to earthworms was studied by observing the mortality rate of earthworms and loss of lipids from earthworm bodies. The results of the study provided information on the bioavailability, i.e., the accumulation of pesticides in earthworms exposed to DDT- and dieldrin-contaminated soil. The bioavailability information was used to develop levels protective of receptors via the food chain model, as discussed further in Section 2.6.4.

Ecological Risk Characterization

Among the ecological COCs identified above, only the following were retained for development of levels for protection of potential ecological receptors: 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, aldrin, dieldrin, endrin, endrin ketone, endrin aldehyde, atimony, lead, mercury and silver. Among the remaining COCs: HPCDD and HPCDF were infrequently detected and not expected to be related to site operations; and arsenic and zinc were detected at levels that were found at levels similar to fill material over much of NSWCDL outside the site, and also were not considered to be related to previous site operations. Therefore, HPCDD, HPCDF, arsenic and zinc were not considered further for development of levels for protection of ecological receptors. Section 2.6.3 presents the development of levels protective of potential ecological receptors for the COCs retained above.,

Uncertainty Analysis

The major sources of uncertainty specific to conditions at Site 25 include:

- Uncertainty in problem definition can arise from ambiguities in characterization of contaminant sources and migration pathways, as well as in the exposure pathway analysis. Data gaps and incomplete or vague information regarding contaminant fate and transport and the environmental receptors present and their ecology may lead to uncertainty in determining complete exposure pathways.

- Uncertainty in exposure assessment includes the methods and assumptions made in the determination of the exposure point concentrations. Except for surface soils, limited numbers of samples were collected from each media, resulting in uncertainty as to how accurately the date represents the site. In addition, the use of maximum detected values to represent site-specific contaminant concentrations is conservative and overestimates risk.

- Uncertainty in ecological effects characterization can result from the qualify of existing data used to support the determination of potential adverse impacts to ecological receptors. The comparison of site data to conservative, published screening values, although necessary, will introduce error into the results of the assessment In addition, the uncertainties associated with extrapolations from results based on laboratory test conditions to field situations have long been acknowledged, but remain difficult to quantify.

- Uncertainty in risk characterization includes that associated with the potential effects of exposure to multiple chemicals and the cumulative uncertainty from combining conservative assumptions in earlier activities. Often conservative conclusions rather than reasonable and appropriate ones are drawn that tend to overestimate risk.

2.6.3 Summary, Conclusions, and Recommendations

In summary, dieldrin and antimony in surface soil and subsurface soil at Site 25 can present human health risks for a potential future resident. No unacceptable human health risks are expected for the current or future base worker or the future construction worker. Ecological receptors at the site are at risk based on concentrations of 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, dieldrin, aldrin, endrin, endrin aldehyde, endrin ketone, antimony, lead, mercury, and silver in the surface soils at Site 25. Risks to ecological receptors from exposure to subsurface soils, and sediments, and intermittently present surface waters outside the source area, are considered to be minimal.

Previous releases of hazardous substances from Site 25, if not addressed by implementing the response action selected in this ROD, may present a threat to public health, welfare, or the environment

2.6.4 Development of Preliminary Rernediation Goals (PRGs)

The COCs fbr surface and subsurface soils were evaluated using contaminant transport modeling to verify the protection of groundwater from contaminants in the surface and subsurface soils, and of nearby surface waters and associated sediments from soil contaminants via the groundwater pathway. Details of the contaminant transport modeling effort are provided in Appendix C of the Site 25 FS.

Human Health PRGs

Human health PRGs were calculated from the major human health risk-based COCs for surface and subsurface soils for the protection of the future resident. Based on these calculations and modeling efforts, PRGs were developed for surface and subsurface soils. The human health PRGs for both surface and subsurface soils at Site 25 include dieldrin (0.67mg/kg) and antimony (18 mg/kg).

Ecological PRGs

The pesticide PRGs were derived using food chain models because concentrations of these compounds tend to increase at higher levels of the food chain. Also, higher animals are more sensitive than soil organisms to most of the DDT- and dieldrin-related compounds. For simplicity, the sums of 4.4'-DDT-R (concentration of 4,4'-DDD, 4,4'-DDE, plus 4,4'-DDT) and dieldrin-R (concentration of aldrin, dieldrin, endrin, endrin aldehyde, plus endrin ketone) were used for developing the pesticide PRGs. PRGs were developed only for soil because that Is the predominant contaminated medium on the site. The drainage ditch in the site contains water only intermittently. A description of the PRG derivation process is provided in Appendix B of the Site 25 FS.

Although pesticides are the main concern at Site 25, a dioxin, a furan, and several metals were characterized in the RI as potential risks to ecological receptors. These analytes have been assigned PRGs from published sources. The dioxin and furan, like the pesticides, are of most concern to higher animals; however, their occurrences at Site 25 were both infrequent and scattered. The metals may harm wildlife, soil organisms, or plants, depending on the relative sensitivity of each type of receptor and, for wildlife, the likelihood of exposure. Ecological PRGs for surface soil at Site 25 include 4,4'-DDT-R (1.0 mg/kg), dieldrin-R (1.0 mg/kg), antimony (5.0 mg/kg), lead (50 mg/kg), mercury (0.10 mg/kg), and silver (2.0 mg/kg).

2.6.5 Remedial Action Objectives (RAOs)

Based on human health and ecological risks at Site 25, and specific site conditions, the following remedial action objectives (RAOs) were developed for site surface and subsurface soils to address the primary exposure pathways. The concentrations indicated below represent levels protective of human health and the environment.

Prevent potential future resident receptors from being exposed to dieldrin and antimony in surface soils and subsurface soils.

Human Health	
COC	Concentration
Dieldrin	0.67 mg/kg
Antimony	18.0 mg/kg

Prevent ecological receptors from being exposed to 4,4'-DDT-R, dieldrin-R, antimony, lead, mercury, and silver present in surface soils (0 to 2 feet bgs).

Ecological	
COC	Concentration
4,4–DDT-R	1.0 mg/kg
Dieldrin-R	1.0 mg/kg
Antimony	5.0 mg/kg
Lead	50 mg/kg
Mercury	0.10 mg/kg
Silver	2.0 mg/kg

2.7 DESCRIPTION OF ALTERNATIVES

A detailed analysis of the possible remedial alternatives for Site 25 is included in the Site 25 Feasibility Study report. The detailed analysis was conducted in accordance with the U.S. EPA document entitled *Guidance for Conducting Remedial Investigations and Feasibility Studies* under CERCLA and the National Oil Hazardous Substances Pollution Contingency Plan.

Alternative 1: No Action

Under Alternative 1 the site is essentially abandoned. No further evaluation of conditions would occur. Alternative 1 serves as a baseline against which the ability of other alternatives to meet remedial action objectives is evaluated.

The following are the cost and duration associated with Alternative 1:

- Present Worth: $15,550 is the estimated administrative cost of 5-year reviews over a 30-year period.

- Time to Implement: 0 months

Alternative 2: French Drain Removal: Soil Cover with Impermeable Liner [Soil Exceeding Remedial Action Objectives (RAOs)]; Institutional Controls (Soil and Groundwater); and Wetlands Restoration

– Option A: Excavation, Consolidation of Soil "Hot Spots" under Soil Cover, and Backfill or
– Option B: Excavation, Off-site Disposal of Soil "Hot Spots, and Backfill

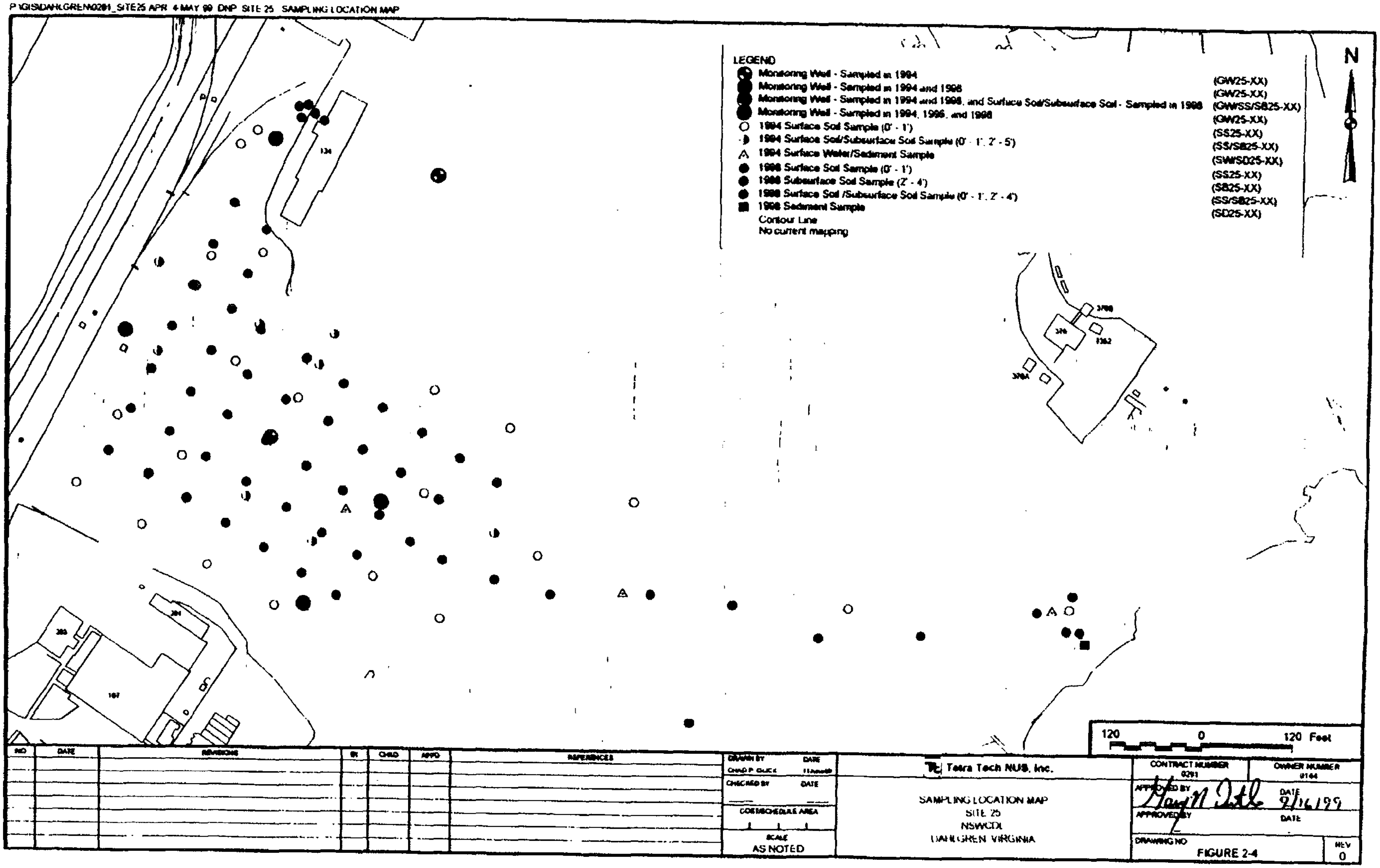
Under Alternative 2, the following actions would be performed

- French Drain Removal: An area of approximately 2500 square feet of contaminated material down to a depth of 4 feet below ground surface (bgs) would be excavated. A total volume of approximately 370 cubic yards of contaminated material would be excavated and disposed off-site. The disposal facility is expected to be a RCRA Subtitle D facility where the material would be directly landfilled. The French Drain removal area is delineated in Figure 2-5. The calculations supporting the volume estimate are presented in Appendix D of the FS.

- Option A: Excavation, Consolidation of Soil “Hot Spots” under Soil Cover, and Backfill: Hot spots I and 2, located outside the soil cover area (Figure 2-5), would be excavated and consolidated within the area of soil exceeding RAOs. Approximately 6075 square feet of area at hot spots 1 and 2 would be excavated to a depth of 1.5 feet. Approximately 338 cubic yards of contaminated soil would be spread over an area of approximately 142,000 square feet Hot spot areas 1 and 2 would be backfilled to grade with clean borrow (common fill) from an off-site location and revegetated. The calculations supporting the area and hot spot volume estimates are presented in Appendix D of the FS.

- Option B: Excavation, Off-site Disposal of Soil "Hot Spots" and Backfill. Hot spots 1, 2. 3, 4 and 5, would be excavated and disposed off-site, as shown on Figure 2-5. Approximately 19,800 square feet of contaminated soil at the five hot spots, would be excavated to a depth of 1.5 feet. The excavated soil corresponds to a volume of 1,100 cubic yards. The excavated area outside the proposed soil cover area (hot spots 1 and 2), would be backfilled to grade with clean borrow soil from an off-site location. The remaining hot spot excavated areas (hot spots 3, 4, and 5) would be regraded. Hot spots 1, 2, 3, 4 and 5. and other onsite areas identified from previous investigations and confirmatory sampling, would be tested for TCLP characteristic waste prior to transport off-site for disposal. Should the soils fail for TCLP, these corresponding areas will be handled as RCRA hazardous waste. Should the soils pass TCLP, then a health-based level shall be used to determine whether the soils are disposed in a Subtitle C or D facility as a non-regulated waste. The health-based level for dieldrin was calculated to be 5.4 mg/kg as provided in Appendix D. Should TCLP and the health-based level pass, the soils would be disposed In a Subtitle D facility.

Soil Cover with Impermeable Liner: A soil cover with an impermeable liner would be placed over an area of 142,000 square feet. Under Option A, this area would include consolidated hot spot soils. Under Option B, no hot spot soil consolidation would be required and the excavated areas in the swale area would be regraded. A minimum area of 142,000 square feet would be cleared/grubbed/graded for a liner to be placed. This area would exceed the area of surface soil where contamination levels exceed RAOs by approximately 26,000 square feet to meet cap grading requirements. A soil cover approximately 2 feet in thickness consisting of soil that is similar in geological properties to the existing uncontaminated soil at the site would be placed over the entire area that would be covered by the liner. In particular, silt/clay/loam type soil would be placed in the areas where wetland restoration is required. The final slope of the surface of the soil layer would be similar to the existing slope of the area under the proposed cover which is approximately 4 percent.


P:\GIS\DAHLGREN\0281_SITE25.APR 4 MAY 99 DNP SITE 25 SAMPLING LOCATION MAP
LEGEND
Monitoring Well - Sampled in 1994 (GW25-XX)
Monitoring Well - Sampled in 1994 and 1998 (GW25-XX)
Monitoring Well - Sampled in 1994 and 1998, and Surface Soil/Subsurface Soil - Sampled in 1998 (GW/SS/SB25-XX)
Monitoring Well - Sampled in 1994, 1996, and 1998 (GW25-XX)
1994 Surface Soil Sample (0' - 1') (SS25-XX)
1994 Surface Soil/Subsurface Soil Sample (0' - 1', 2' - 5') (SS/SB25-XX)
1994 Surface Water/Sediment Sample (SW/SD25-XX)
1998 Surface Soil Sample (0' - 1') (SS25-XX)
1998 Subsurface Soil Sample (2' - 4') (SB25-XX)
1998 Surface Soil /Subsurface Soil Sample (0' - 1', 2' - 4') (SS/SB25-XX)
1998 Sediment Sample (SD25-XX)
Contour Line
No current mapping
N
120 0 120 Feet
Tetra Tech NUS, Inc.
SAMPLING LOCATION MAP
SITE 25
NSWCDL
DAHLGREN, VIRGINIA
CONTRACT NUMBER
OWNER NUMBER
APPROVED BY
DATE
9/16/99
DRAWING NO.
FIGURE 2-4
REV
0
AS NOTED

This page intentionally left blank

- Wetlands Restoration: Vegetation similar to the existing plants and shrubs in the wetland areas of the site would be planted in the soil cover in areas where wetlands would have been cleared. The use of a liner (preferably of geocomposite clay material) is expected to aid moisture retention in the soil cover and wetland re-establishment. Vegetation similar to upland plants and shrubs would be planted in all remaining areas of soil cover. The edges of the soil cover would be provided with erosion protection (gravel or gabion baskets) in the event of storms. Additional wetlands mitigation may be required.

Institutional Controls: A Land Use Control Assurance Plan (LUCAP) and Land Use Control Implementation Plan (LUCIP) would be developed to assure implementation of the following measures. Records of the contamination would be placed in the NSWCDL Master Plan to prevent site development for residential use. Access to the site would be restricted to prevent human intrusion into the soil cover. Deed notation would be required to limit future disturbances to the site and establish other appropriate site use limitations. In the event of sale of this property , the deed would carry a restriction preventing the potable use of groundwater, and allowing only industrial use of the land. Groundwater at the site is not currently used and is unlikely to be used within the foreseeable future under the Navy's ownership. Groundwater samples would be taken from 4 monitoring wells (including a background well) and analyzed for pesticides and inorganics. A report on the site conditions would be issued at each five-year review event.

The costs associated with Alternative 2 are shown in the following table. Details of the cost estimate are presented in Appendix E of the FS.

ALTERNATIVE 2		
COST	**OPTION A**	**OPTION B**
Capital:	$1,495,000[1] or $1,599,000[2]	$1,608,000[3] or $2,053,000[4]
Operating and Maintenance (O&M)	$5,600/yr + $9,000/5 yr	$5,600/yr + $9,000/5 yr
Present Worth (30-year @ 7% discount rate)	$1,584,000[1] or $1,687,000[2]	$1,696,000[3] or $2,142,000[4]

1 Assumes French-Drain material disposal at Subtitle D landfill.
2 Assumes French-Drain material disposal at Subtitle C landfill.
3 Assumes French-Drain material and hot spot soil disposal at Subtitle D landfill.
4 Assumes French-Drain material and hot spot soil disposal at Subtitle C Landfill.

- Time to Implement: 4 months

Alternative 3: French Drain Removal: Excavation and Off-site Dismal (Soil Exceeding RAOs), and Backfills and Wetlands Restoration

Under Alternative 3 the following actions would be performed:

- French Drain Removal: This component would be identical to that of Alternative 2.

- Excavation, Off-site Disposal (Soil Exceeding RAOs), and Backfill: Soil contaminated with concentrations greater than the RAOs in Section 2.6.5 (area shown on Figure 2-5) covering an area of approximately 122,000 square feet (including approximately 19,800 square feet from the five hot spots) would be excavated to a depth of 2 feet bgs to meet ecological RAOs. An additional volume of 139 cubic yards would be excavated from subsurface soils (to an average depth of 4.5 feet bgs) at Hot spots 6 and 7 (also shown on Figure 2-5) to meet human health RAOs. Approximately 9,200 cubic yards of soil would be disposed off-site. Hot spots 1, 2, 3, 4 and 5, and other onsite areas identified from previous investigations and confirmatory sampling, would be tested for TCLP characteristic waste prior to transport off-site for disposal. Should the soils fail for TCLP, these corresponding areas will be handled as RCRA hazardous waste. Should the soils pass TCLP, then a health-based level shall be used to determine whether the soils are disposed in a Subtitle C or D facility as a non-regulated waste. The health-based level for dieldrin was calculated to be 5.4 mg/kg as provided in Appendix D. Should TCLP and the health-based level pass, the soils would be disposed in a Subtitle D facility.

- Backfill: Fill material approximately 2 feet in thickness consisting of soil that is similar to the existing soil at the site would be backfilled in the excavated areas within the swale. In particular, silt/clay/loam type of soil would be backfilled in the areas where wetland restoration is required. As before, hot spots excavated outside the soil cover area would be backfilled with common hit soil. The final grade and elevations of the surface of the backfilled soil would be similar to the existing grade and elevations of the existing contaminated area.

- Wetlands Restoration: The excavated areas would be revegetated after backfilling to grade. Vegetation similar to the existing plants and shrubs in the wetland areas of the site would be re-established. Vegetation similar to the existing upland plants and shrubs would be planted in remaining area affected by excavation. No additional erosion protection is expected to be required. Additional wetlands mitigation may be required.

Implementation of Alternative 3 would make the site available for unrestricted land and groundwater use. However, certain metals in groundwater are found at levels that would be of concern in drinking water. These metals (iron and manganese) were found to be naturally occurring in the area and therefore are not attributable to the site.

The costs associated with Alternative 3 are as follows:

ALTERNATIVE 3	
Capital Cost	$1,517,000[1] or $2,049,100[2]
Operating and Maintenance	$0
Present - Worth (30-year @ 7% discount rate)	$1,517,000[1] or $2,049,100[2]

1 Assumes all soil/material disposal at Subtitle D landfill,
2 Assumes French-Drain material and hotspot soil disposal at Subtitle C landfill and remaining soil disposal at Subtitle D landfill.

Details of the cost estimate are presented in Appendix E of the FS.

- Time to Implement: 6 months

2.8 SUMMARY OF THE COMPARATIVE ANALYSIS OF ALTERNATIVES

The remedial alternatives described in Section 2.6 were evaluated in the Feasibility Study against nine criteria identified in the NCP, as presented below.

2.8.1 <u>Threshold Criteria</u>

Overall Protection of Human Health and the Environment

Alternative 3 would be the most protective of all alternatives because the contaminated soil would be removed from the site. Alternative 2 would also be protective, although less reliable than Alternative 3 in the long term because the contaminated soil would remain on site and only the exposure pathway of incidental ingestion or dermal contact would be blocked using a soil cover. Under Alternative 2, Option B would be more protective than Option A because the most highly contaminated soil (hot spots) would be removed from the site in the former option, whereas, they would only be consolidated under the cover in the latter option. Alternative I would not be protective since the potential for receptors to be exposed to contaminants remains. Because Alternative 1 does not meet the threshold criteria of protecting human health and the environment, it will not be considered further in this analysis.

Compliance with ARARs and TBCs

Alternatives 2 and 3 would comply with chemical-specific, location-specific and action-specific ARARs.

2.8.2 Primary Balancing Criteria

Reduction of Toxicity, Mobility or Volume through Treatment

There would be no reduction in toxicity, mobility or volume through treatment in any of the alternatives.

Long-term Effectiveness

Alternative 3 would be permanent and most effective in the long-term because the contaminated soil would be removed from the site and disposed of under regulated and controlled conditions offsite. Alternative 2 would also be permanent, but less effective in the long-term than Alternative 3 because the soil cover would have to be maintained. Under Alternative 2, Option B would be more reliable than Option A because the most highly contaminated soil would be removed from the site whereas the potential for exposure to receptors would remain under Option A.

Short-term Effectiveness

Option A under Alternative 2 would be the most effective in the short-term because the smallest volume of contaminated material would be excavated and therefore, the potential for workers on site to be exposed to contaminants would be the least. Option B under Alternative 2 would be somewhat less effective than Option A and Alternative 3 would be ft least effective because of greater potential for exposure to contaminants and the longer time (6 months vs. 4 months) to reach RAOs. However, in both alternatives with proper use of personal protective equipment engineering controls, etc., all exposure can be adequately minimized and therefore both alternatives would be effective in the short term. Durations of remedial action under the options for Alternative 2 (approximately 4 months) are expected to be shorter than the duration of remedial action under Alternative 3, which is estimated to be 6 months.

Implementability

Wetland restoration under Alternative 3 is likely to be easier to implement than under Alternative 2. Under Alternative 2, Option B would be somewhat easier to implement with regard to wetland restoration than Option A because the surface elevation would be lower and consequently more conducive to saturation.

Cost

The following table compares the costs of the alternatives.

ALTERNATIVE 2		ALTERNATIVE 3
OPTION A	OPTION B	
Capital: $1,495,000$^{(1)}$ $1,599,000$^{(2)}$ O&M: $5,600/yr + $9,000/5yrs Present-Worth: $1,584,000$^{(1)}$ or $1,687,000$^{(2)}$	Capital: $1,608,000$^{(1)}$ or $2,053,000$^{(2)}$ O&M: $5,600/yr + $9,000/5yrs Present-Worth $1,696,000$^{(1)}$ $2,142,000$^{(2)}$	Capital: $1,517,000$^{(1)}$ or $2,049,000$^{(2)}$ O&M: $0 Present-Worth $1,517,000$^{(1)}$ or $2,049,000$^{(2)}$

1 Assumes a Subtitle D landfill for disposal of all soil/French Drain material.
2 Assumes a Subtitle C landfill for disposal of hot spot soils and French Drain material and a Subtitle D landfill for disposal of all remaining soil.
3 Administrative Costs of 5-year reviews over 30-year duration.

2.8.3 Modifying Criteria

State Acceptance

The Virginia Department of Environmental Quality, on behalf of the Commonwealth of Virginia, has reviewed the information available for this site and has concurred with this ROD and the selected remedy identified below. A copy of the letter of concurrence from the Commonwealth of Virginia is attached as Appendix A.

Community Acceptance

The selected remedy was presented to the public in a public meeting along with the Proposed Plan. Minutes of the public meeting are presented in Appendix B. Questions raised by members of the community are addressed in the Responsiveness Summary presented in Section 3.0. Based upon the outcome of the public meeting, participants at the meeting did not disagree with the selected remedy.

2.9 THE SELECTED REMEDY

The selected remedy, Alternative 3. consists of excavation and off-site disposal of contaminated soils and fits the Navy strategy to reduce risks at all NSWCDL sites with minimal long-term care. The remedial action selected in this ROD addresses contamination associated with Site 25 pesticide rinse contents, surface soils, subsurface soils and sediments. The selected remedy for Site 25 is excavation and off-site disposal of all soil contaminated with pesticides and inorganics at levels exceeding Remedial Action Ob)ectives (RAOs) for protection of potential ecological and human receptors. The excavated areas will be backfilled and revegetated and the wetlands restored. The RAOs for the Chemicals of Concerns (COCs) are as follows:

Human Health	
COC	Concentration
Dieldrin	0.67 mg/kg
Antimony	10.0 mg/kg
Ecological	
COC	Concentration
4,4'-DDT-R	1.0 mg/kg
Diedrin-R	1.0 mg/kg
Antimony	5.0 mg/kg
Lead	50 mg/kg
Mercury	0.10 mg/kg
Silver	2.0 mg/kg

Based on available information and that current understanding of site conditions, Alternative 3 appears to provide the best balance of the nine NCP evaluation criteria. In addition, the selected alternative is anticipated to meet the following statutory requirements:

- Protection of human heafth and the environment
- Compliance with ARARs
- Cost effectiveness
- Use of a permanent solution to eliminate site risks by removing contaminated soil from the site and disposing of the sail at an oftite landfill. The soil could be used as a daily cover at the selected landfill, thereby providing resource recovery to the maximum extent possible.

The selected remedy does not achieve the preference for the reduction of toxicity, rmbility, and volume through treatment because potential treatment technologies were not effective and were too costly.

The major components of the selected remedy are as follows:

- French Drain and Contaminated Soil Removal: Excavation of approximately 370 cubic yards of soil covering an area of approximately 2,500 square feet to a depth of 4 feet below ground surface (bgs) in and around the French Drain at Site 25.

- Excavation of Contaminated Soil in the Source Area Exceeding the RAOs: Excavation of approximately 9,200 cubic yards of soil covering an area of approximately 122,000 square feet to a depth varying from 2 to 4.5 feet bgs

- Off-site Disposal of the contaminated soil : Disposal of approximately 9,570 cubic yards of soil by direct landfilling at an offsite facility. The excavated soil will be tested using the Toxicity Characteristic Leaching Procedure (TCLP) to determine if it is hazardous or nonhazardous waste for off-site disposal, as appropriate. If the soil passes the TCLP, it is not a hazardous waste and Land Disposal Restrictions (LDRs) do not apply. If the concentration of dieldrin exceeds the health-based risk level of 5.4 mg/kg, however, the soil will be manifested and disposed of in a RCRA Subtitle C landfill. Specifically, hot spots 1, 2, 3. 4 and 5, and other onsite areas identified from previous investigations and confirmatory sampling, would be tested for TCLP characteristic waste prior to transport off-site for disposal. Should the soils fail for TCLP, these corresponding areas will be handled as RCRA hazardous waste. Should the soils pass TCLP. then a health-based level shall be used to determine whether the soils are disposed in a Subtitle C or D facility as a non-regulated waste. The health-based level for dieldrin was calculated to be 5.4 mg/kg as provided in Appendix D. Should TCLP and the health-based level pass, the soils would be disposed in a Subtitle D facility.

- Site Restoration: The excavated area in and around the French Drain will be backfilled to previous grade and a vegetative cover will be placed on the surface. The excavated area in the wetland where soil exceeding RAOs were present, will be regraded, backfilled, and revegetated to the extent necessary to reestablish and, if possible, enhance the wetland area. Additional wetlands mitigation may be required.

2.9.1 Performance Standards

Excavation and Off-site Disposal

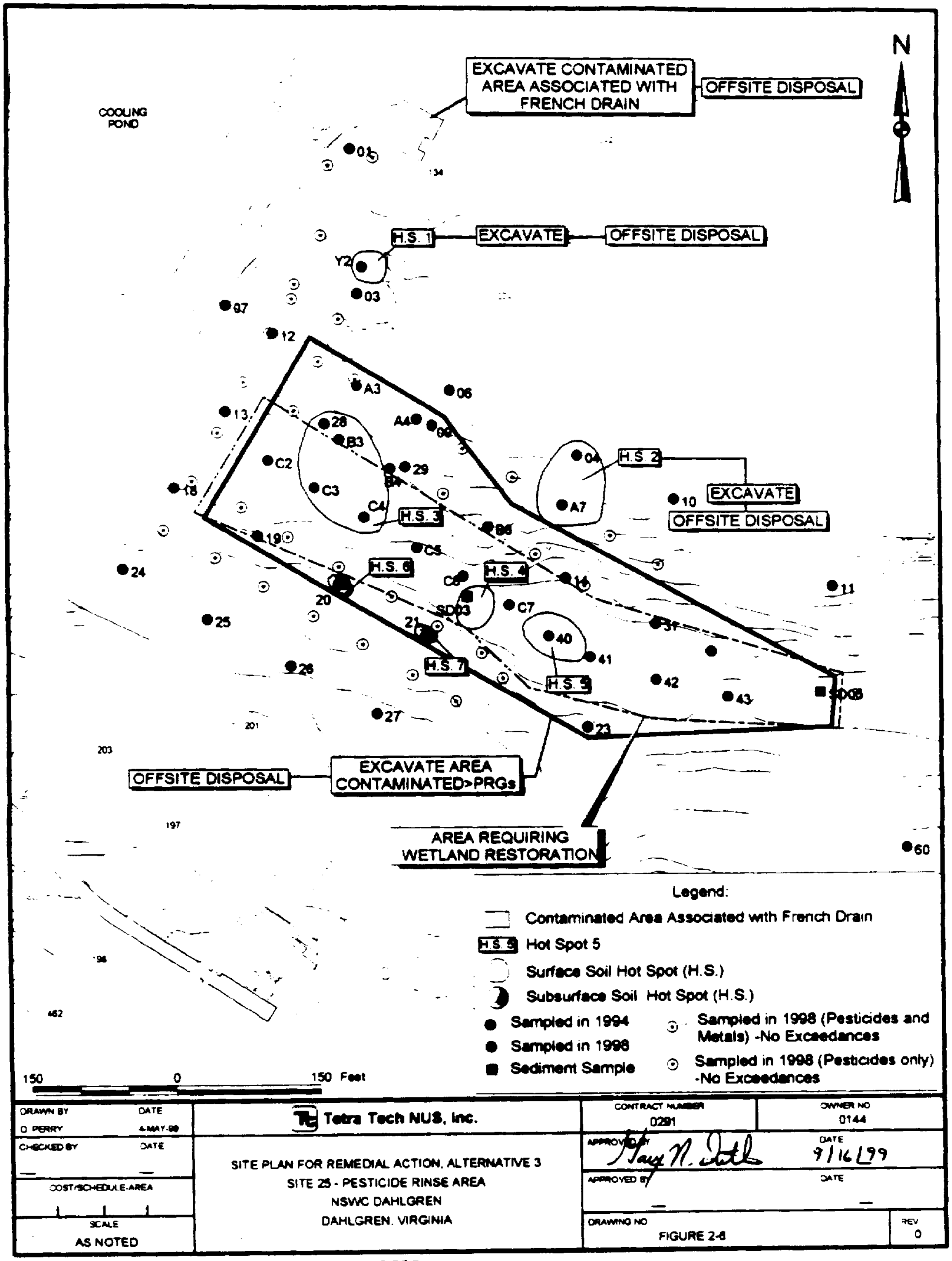
The proposed areas of excavation are shown on Figure 2-6. These areas have been delineated based on data indicating concentrations of pesticides and inorganics greater than RAOs in Section 2.6.5.

Following excavation to a depth of 2 feet. confirmatory sampling of the bottom (for human health RAOs only) and side walls (for both ecological and human health RAOs) shall be conducted to ensure that the mean of the residual levels of each of the COPCs does not exceed its respective RAO at a 95 percent upper confidence limit.

Approximately 2,500 square feet of area in and around the French Drain will be cleared and excavated to a depth of approximately 4 feet below ground surface. The resultant volume of soil and French Drain material (including any gravel or brick lining) corresponding to a total in-situ volume of 370 cubic yards will be loaded onto trucks for offsite disposal.

Approximately 122,000 square feet of surface soil in the pesticide rinse area will be cleared of vegetation and excavated to a depth of 2 feet below ground surface. Within this area, approximately 19,800 square feet of soil is expected to contain pesticide hotspots, i.e., soil with DDT-R or dieldrin-R levels exceeding 5.0 milligrams per kilogram, that are labeled as H.S. 1, H.S. 2. H.S. 3, H.S. 4, and H.S. 5. Also within this area, two hotspots containing inorganic contaminants at concentrations greater than the RAOs shall be excavated. The excavation area is anticipated to be approximately 1,500 square feet (total) to a depth of 4.5 feet below ground surface. A total in-situ volume of approximately 9,300 cubic yards of soil will be excavated and loaded onto trucks for offsite disposal.

Excavated material shall be disposed at a permitted RCRA Subtitle D landfill offsite. Hot spots 1, 2, 3, 4 and 5, and other onsite areas identified from previous investigations and confirmatory sampling, would be tested for TCLP characteristic waste prior to transport off-site for disposal. Should the soils fail for TCLP, these corresponding areas will be handled as RCRA hazardous waft. Should the soils pass TCLP, then a health-based level shall be used to determine whether the soils are disposed in a Subtitle C or D facility as a non-regulated waste. The health-based level for dieldrin was calculated to be 5.4 mg/kg as provided in Appendix D. Should TCLP and the health-based level pass, the soils would be disposed in a Subtitle D facility. approximately 2 feet in thickness consisting of soil that is similar in geological properties to the existing uncontaminated soil at the site would be placed over the entire area that would be covered by the liner. In particular, silt/clay/foam type soil would be placed in the areas where wetland restoration is required. The final slope of Me surface of ft soil layer would be similar to the existing slope of the area under the proposed cover which is approximately 4 percent



P:\GIS\DAHLGREN\0291_SITE25 APR 11June99 CPG SITE PLAN - ALTERNATIVE 3 LAYOUT [2-8]

This page intentionally left blank

During excavation and backfilling operations, erosion and sedimentation controls shall be established to minimize impacts to downgradient areas of the site, especially Upper Machodoc Creek. Erosion and Sediment Control Regulations (4VAC 50-30-10 to 110) shall be complied with during these activities.

Backfill

Backfilled material in the French Drain area will consist of common fill with a vegetative topsoil cover. However, backfilled material in the remaining areas, especially within the swale shall be silty/clay/foam type of soil similar in geological characteristics to those currently existing at the site. Backfilling shall be to the extent necessary to maintain or even enhance the area of wetlands reestablishment. The minimum volume of excavation requiring backfilling is expected to be approximately 139 cubic yards corresponding to the deeper excavation in the Hot Spot areas H.S. 6 and H.S. 7. Additional backfilling may be used as required to meet grading requirements and to the extent necessary to prevent excessive ponding of water. A vegetative cover shall be similar to those currently existing at the site.

Wetlands Restoration

A minimum area of approximately 72,000 square feet shall be planted with wetland species of plants and shrubs that are similar to those currently existing at the site. The restoration of wetlands at the site shall be conducted in accordance with the applicable portions of Erosion and Sediment Control Regulations (4VAC 50-30-10 to 110), Protection of Wetlands and Floodplains (E.O. 11990, 11998), Virginia Water Protection Permit Regulation (9 VAC 25-210-10 to 260), Wetlands Mitigation Compensation Policy (4 VAC 20-390-10 to 50) and relevant portions of the Clean Water Act (Sections 404 and 401). Additional wetlands mitigation may be required.

Details of the excavation, backfilling and restoration will be addressed in the detailed design. The actual quantities of excavated material as determined during remedial design and as a result of implementation of the remedy could vary from the estimates presented above.

2.9.2 <u>Summary of the Estimated Remedy Costs</u>

The estimated cost of the selected remedy is as follows:

- $ 1,517,000 assuming all of the material will be disposed of at a RCRA Subtitle D landfill

The estimated alternative (contingency) cost of the selected remedy is as follows:

- $ 2,049,000 assuming that approximately 1,470 cubic yards (consisting of 1,100 cubic yards from Hot Spots 1, 2, 3, 4 and 5 + 370 cubic yards from the French Drain area) will be disposed of at a RCRA Subtitle C landfill and the remainder of the soil will be disposed of at a RCRA Subtitle D landfill.

The costs also assume conservatively, that the excavated areas will be backfilled to previous ground surface elevations. However, as discussed earlier, the excavated areas may need to be backfilled only partially, depending on the final design requirements for wetlands restoration. Table 2-3 presents a breakdown of estimated capital costs associated with the remedy and the alternative contingency remedy, respectively. There are no operating and maintenance costs associated with the selected remedy, therefore, the 30-year present worth cost is identical to the capital cost.

2.9.3 Expected Outcomes of the Selected Remedy

The expected outcomes of implementing the selected remedy in terms of land and resource uses and risk reduction are as follows:

- Within approximately 6 months after remedial action contract award, the site shall be returned to unrestricted use.

- Groundwater currently meets federal primary drinking-water standards (MCLs) for contaminants associated with the site, and it is anticipated to continue to meet these standards following the remedial action.

The basis and rationale for the cleanup levels that will allow the selected remedy to meet ecological protection and human health risk reduction have been described in Section 2.6.2.

2.10 STATUTORY DETERMINATIONS

Remedial actions must meet the statutory requirements of Section 121 of CERCLA 42 U.S.C. 9621 as discussed below. Remedial actions undertaken at NPL sites must achieve adequate protection of human health and the environment comply with ARARS of both Federal and state laws and regulations, be cost-effective, and utilize, to the maximum extent practicable, permanent solutions and alternative treatment or

TABLE 2-3

CAPITAL COST ESTIMATE FOR SELECTED REMEDY
SITE 25-PESTICIDE RINSE AREA
NSWCDL, DAHLGREN, VIRGINIA
PAGE 1 OF 2

Item #	Cost Item/Components	Quantity	Unit	Unit Cost	Total Cost
1.	**Mobilization/Demobilization** (includes trailer rental and utilities for 6 months)	1	ls	30,000	30,000
2.	**Decontamination Facilities** (includes water storage, personnel protective equipment and wastewater disposal)	1	ls	87,000	87,000
3.	Excavation, Disposal, Restoration (French Drain Area)				
	Clear and Grub	0.1	ac	1833	183
	Excavation	370	cy	1.76	651
	Haul for Disposal	2,380	mile	4	9,520
	Disposal	555	ton	25	13,875
	Disposal TCLP testing	2	ea	358	716
	Confirmatory sampling of excavation	5	ea	278	1,390
	Purchase/haul/place/spread/compact fill	320	cy	8	2,560
	Purchase/haul/place/spread top soil	50	cy	23	1,150
	Revegetate	333	sy	1.60	533
4.	**Excavation, Disposal, Restoration (Area>Action Levels)**				
	Clear and Grub	3.4	ac	1833	6232
	Excavation	9,181	ac	1.76	16,159
	Haul for Disposal (690 trips @ 85 mi/trip)	58,650	mi	4	234,600
	Disposal	12,395	ton	25	309,875
	Disposal TCLP testing	4	ea	358	1,432
	Confirmatory sampling of excavation	20	ea	278	5560
	Purchase/haul/place/spread/compact fill	2782	cy	8	22,256
	Purchase/haul/place/spread top soil	927	cy	23	21,321
	Revegetate	5,564	sy	1.60	8902
5.	**Wetlands Restoration**				
	Purchase/haul/place/spread/compact silty clay fill	4,139	cy	8	33,112
	Purchase/haul/place/spread loam	1,380	cy	23	31,740
	Selection/purchase/planting of wetland species of vegetation	1.7	ac	10,000	17,000

TABLE 2-3

CAPITAL COST ESTIMATE FOR SELECTED REMEDY
SITE 25-PESTICIDE RINSE AREA
NSWCDL, DAHLGREN, VIRGINIA
PAGE 2 OF 2

Item #	Cost Item/Components	Quantity	Unit	Unit Cost	Total Cost
6.	**Other Costs**				
	Overhead and G&A Costs				99,344
	Indirects on labor cost and profit				108,217
	Health and Safety monitoring				55,560
	Contingency				233,351
	Engineering				116,675
	Total				**1,516,780 or 2,048,832** [(1)]

resource recovery technologies. Also, remedial alternatives that reduce the volume, toxicity, and/or mobility of hazardous waste as the principal element are preferred. The following discussion summarizes the statutory requirements that are met by the selected remedy.

2.10.1 Protection of Human Health and the Environment

The selected remedy will be protective of human health and the environment because the contaminated soil that could pose a potential risk will be removed from the site.

2.10.2 Compliance with ARARs

The selected remedy will meet all identified ARARs as provided in Appendix C. The remedy will comply with Safe Drinking Water MCLs that are applicable to groundwater at the site since current groundwater concentrations are already in compliance with these standards and the potential for future impact to the groundwater by leaching of soil contaminants will be minimized by removal of the contaminated soil. The selected remedy will comply with Virginia Water Quality Standards because the potential for future impact to surface water by erosion of contaminated surface soil will be minimized by the removal of contaminated soil. The selected remedy will also be conducted in compliance with the following action-specific ARARs:

- Commonwealth of Virginia Erosion and Sediment Control Regulations (4VAC 50-30-10 to 110) applicable to minimizing erosion of surface soil during excavation as well as during restoration

- Commonwealth of Virginia Ambient Air Quality Standards (9VAC 5-30-260) applicable to control of dust emissions during excavation/backfilling of contaminated soil

- Executive Order on Wetlands and Floodplains (E.O. 11990 and E.O. 11998), Virginia Water Protection Permit Regulation (9 VAC 25-210-10 to 260) applicable to wetlands restoration, and Wetlands Mitigation Compensation Policy (4 VAC 20-390-10 to 50)

- Clean Water Act (Sections 404 and 401) relevant portions that address placement of fill in wetlands

A more detailed evaluation of ARARs is provided in Appendix C.

2.10.3 Cost-Effectiveness

The selected remedy is cost effective because it would provide overall effectiveness proportional to the cost. The selected remedy is very similar in cost to the other alternatives (less than 21 percent higher than Alternative 2), but removes the contaminated media from the site.

2.10.4 Utilization of Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Practicable

The selected remedy uses a permanent solution that effectively removes the contaminated soil from the site and disposes of the soil at a permitted landfill offsite. Assuming that a majority, if not all of the soil will be considered nonhazardous, the soil could potentially be incorporated within daily cover material at the selected RCRA Subtitle D landfill off site. Therefore, the remedy offers resource recovery to the maximum extent practicable by reusing the soil under controlled conditions.

2.10.5 Preference for Treatment as a Principal Element

The selected remedy does not utilize treatment as a principal element. The evaluation of treatment technologies has shown that there are no practical and cost effective processes that can remove both pesticide and inorganic contaminants from the soil while maintaining suitable geological characteristics for reuse for this site.

2.10.6 Five-Year Review Requirements

Because this remedy will not result in hazardous substances remaining onsite above levels that allow for unlimited use and unrestricted exposure, a five-year review will not be required for this remedial action.

2.10.7 Documentation of Significant Changes

The selected remedy is the same alternative identified as the recommended alternative in the Proposed Remedial Action Plan and that was presented to the public at the public meeting held July 28, 1999.

No significant changes were made to the recommended remedial action alternative in the Proposed Plan.

3.0 RESPONSIVENESS SUMMARY

No written comments, concerns, or questions were received by the Navy, USEPA, or the Commonwealth of Virginia during the public comment period from July 21, 1999 to August 19, 1999. A public meeting was held on July 28, 1999 to present the Proposed Plan for Site 25 and to answer any questions on the Proposed Plan and on the documents in the information repositories. A 30-minute presentation was provided during which questions were addressed. A summary of questions and answers of the public meeting are attached in Appendix B.

3.1 BACKGROUND ON COMMUNITY INVOLVEMENT

The Navy and NSWCDL have had a comprehensive public involvement program for several years. Starting in 1993 a Technical Review Committee (TRC) met on average twice a year to discuss issues related to investigative activities at NSWCDL. The TRC was composed of mostly governmental personnel; however, a few private citizens attended the meetings.

In early 1996 the Navy converted the TRC into a Restoration Advisory Board (RAB) and eight to ten community representatives joined. The RAB is co-chaired by a community member and has held meetings approximately every 4 to 6 months. The RI/FS and the Proposed Plan for Site 25 were discussed at the RAS meetings.

Community relations activities for the final selected remedy include the items below:

- The documents concerning the investigation and analysis at Site 25, as well as a copy of the Proposed Plan, were placed in the information repository at the NSWCDL General Library and the Smoot Memorial Library.

- Newspaper announcements on the availability of the documents and the public comment period/meeting date was placed in *The Journal* on July 14, 1999 and the *Freelance Star* newspaper on July 19, 1999.

- The Navy established a 30-day public comment period starting July 21, 1999 and ending August 19, 1999 to present the Proposed Remedial Action Plan. No written comments were received during the 30-day public comment period.

- A Public Meeting was held July 28, 1999 to answer any questions concerning the Site 25 Proposed Plan. Approximately 10 people, including Federal, state, and local government representatives attended the meeting.

APPENDIX A

COMMONWEALTH OF VIRGINIA CONCURRENCE LETTER

COMMONWEALTH of VIRGINIA

James S. Gilmore, III
Govenor

John Paul Woodley, Jr
Secretary of Natural Resources

DEPARTMENT OF ENVIRONMENTAL QUALITY
Street Address: 629 East Main Street, Richmond, Virginia 23219
Mailing Address: P.O. Box 10009, Richmond, Virginia 23240
Fax (804) 698-4500 TDD (804) 698-4021
http://www.deq.state.va.us

Dennis H. Tracy
Director

(804) 698-4000
1-800-595-5482

September 23, 1999

Mr. Abraham Ferdas, Division Director
Hazardous Site Cleanup Division (3HS00)
U.S. Environmental Protection Agency, Region III
1650 Arch Street
Philadelphia, PA 19103-2029

Re: Concurrence with Record of Decision for Site 25, NSWC Dahlgren, Virginia

Dear Mr. Ferdas:

The Virginia Department of Environmental Quality staff has reviewed the Record of Decision ("ROD") for Site 25, the Pesticide Rinse Area at the Naval Surface Warfare Center, Dahlgren, Virginia. On behalf of the Commonwealth of Virginia, we concur with the selected remedial alternative as outlined in the ROD dated September 1999.

Should you have any questions concerning this letter, please feel free to contact Dave Gillispie at (904) 699-4209.

Very truly yours,

Erica S. Dameron

Erica S. Dameron
Director, Office of Remediation Programs

cc: Ryan Maya, ChesDiv
Ann Swope, NSWC Dahlgren
Bruce Beach, EPA Region III
Hassan Vakili, VDEQ
Durwood Willis, VDEQ
Dave Gillispie, VDEQ

APPENDIX B
PUBLIC COMMENTS

APPENDIX B

SUMMARY OF QUESTIONS FROM 28 JULY 99 PUBLIC MEETING

<u>Site 25</u>

How do you determine if you've removed all of the contaminated soil?

Prior to excavation, a Verification Sampling Plan is reviewed and approved by U.S. EPA Region lll, VDEQ and the Navy. The Plan outlines an approach for sampling (i.e., grid or random). Once the excavation is performed, sampling and analysis is performed at these locations. This information is reviewed by the regulators and the Navy for a decision on the remaining soils.

Will there be problems during excavation due to wet conditions?

Site 25 may contain wet areas, however, we will minimize construction during wet times of the year by performing this operation toward the end of summer, during dryer periods. Should we encounter wet soils, they will be stabilized prior to offsite transportation and disposal.

NAVAL SEA SYSTEMS COMMAND

NAVAL SURFACE WARFARE CENTER
DAHLGREN DIVISION

PUBLIC MEETING

THURSDAY, JULY 28, 1999, 7:00 P.M.
KING GEORGE COUNTY COURTHOUSE
KING GEORGE, VIRGINIA

PROPOSED REMEDIAL ACTION PLAN
Site 19, Transformer Draining Area
Site 29, Battery Service Area
Site 25, Pesticide Rinse Area

ORIGINAL

USEPA Region III
Hazardous Site Cleanup Division
Federal Facilities Section
Mr. Bruce Beach
1650 Arch Street, Philadelphia, Pennsylvania 18107

Virginia Department of Environmental Quality
Mr. David Gillispie
629 East Main Street, Richmond, Virginia 23219

Public Affairs Office
Commander, Naval Surface Warfare Center
Ms. Jennifer Wilkins
17320 Dahlgren Road, Mail Code CD06 Dahlgren, Virginia 22448

Reported by: Lola Gail Serrett

July 28, 1999:

MS. SWOPE: Good evening, everyone. I want to welcome you tonight to our public meeting that we're having for the public comment period which announces proposed remedial actions for three sites at the Naval Surface Warfare Center, that the Navy, the Commonwealth of Virginia and the Environmental Protection Agency have chosen as the proposed plans that we would like to remediate these sites with. We're going to present a brief synopsis of that action to you tonight. You have -- some of you have seen copies of the documents. They went down to the RAB members. They're also in the Smoot Library and the Dahlgren Library and we have copies on base, if you'd like to see it. The information is on the back on how to contact us with more questions. Yeah, they're in the back of the room.

Also, I want to introduce to Dave Misenhimer. He works for Tetratch, NUS. He's gong to do the presentations tonight. He is probably the chief member of our contracting team that does all our investigations for us and most of the design work, all of his Tetratech teams. So, Dave, I'll let you take it away.

MR. MISENHIMER: Okay.

MS. SWOPE: Oh, one more thing. I'm sorry. Just so you know, this is –- we have a court reporter here. We're recording everything tonight. Your comments are welcome, but we want to document those comments so we can properly respond to your comments since this is a public comment period. So, feel free to interject whenever you have a question, concern or need clarification.

MR. MISENHIMER: Thank you. Okay. This machine is just beginning to warm up. But as Ann just said, there's two documents that are in the back of the room there. The first one deals with two sites; Site 19 and Site 29. And I'm going to go through Site 19 first, followed by Site 29. The second document deals with Site 25 entirely.

MS. SWOPE: That's reversed.

MR. MISENHISER: I don't know what

happened here. Let’s try this again.

MS. SWOPE: It was working beautifully, too.

MR. MISENHIMER: Yeah, It was working.

MR. FUSCALDO: You got a discount because it’s upside down.

MS. SWOPE: Exactly. You can show the location on the map.

MR. MISENHIMER: Yeah. The three sites that we’re dealing with –- Site 19, is located right here. This is main side, here’s 301, the Potomac River, Upper Machodoc Creek. So, Site 19 is kind of on the south side of main side. Site 29 is a little further south, over here. And Site 25 is located on the drain swell here that feeds into Upper Machodoc Creek.

Now, it’s working. Okay. I don’t know what happened. Anyway, so we’re going to start out with Site 29 –- Site 19. And both, Site 19 and 29, are grouped together because these are two sites where we did some remedial action in the past and we're proposing that no further action be taken upon those two sites; whereas, Site 25, we have not done any remedial action to date and we are proposing to do some remedial action. That's what we'll be focusing on today.

So, at Site 19, this was a transformer drainage area. Transformers were drained on the ground and transformer oil typically, in the days when this occurred, had PCB oil in the transformers. PCBs were found to be a human health risk and they were present in the soil where the transformers were drained. So, in 1994, the PCB contaminated soil was removed.

MS. SWOPE: This site is right south of the sea plane hangar.

MR. MISENHIMER: Here's an aerial photo of the site. This area in red is Site 19. It's adjusted to Site 40, which is another site that is currently under investigation in the Installation Restoration Program at Dahlgren. And there's some concrete pads, here, where they stored the transformers and this is generally the area where transformer oil was dumped. This area, in general, is fairly flat, so anything that was dumped out here didn't really move too far. Groundwater generally flows in this direction, to the east. And approximately a thousand gallons of transformer oil were dumped there in the past –- drained their in the pasted.

Here's a site photo. In fact, the concrete pad I pointed out to you is right here. Here's a monitoring well. The area where transformer oil was drained is over in this area and this is the area where, in 1994, the contaminated soil was removed. The area that was –- where the removal occurred was about twenty-five feet by seventy feet, in length and width. And the soil was removed down to a depth of approximately two feet. So, there were about a hundred and seventy-seven cubic yards of soil that were removed, in total, from the site. The target cleanup level for the PCB contaminated soil was a residential land use value that US EPA has established, which is one part per million. And cleanup was successful in getting all the contaminated soil out of there and verification sampling verified that we did reach that level.

MR. FUSCALDO: I mean, have the monitoring wells picked up anything?

MR. MISENHIMER: No, there’s really –- well, one thing I should –- this is what I want to point out here. In terms of groundwater, because we have Site 40 very close by and that site is being investigated, we decided to address groundwater with that adjacent site when we look at that site. It didn’t make a lot of sense to try and break one area up from the other. So –-

MS. SWOPE: (interjecting) But we have not found PCBs in the groundwater.

MR. MISENHIMER: Right.

MR. FUSCALDO: The clinic is there someplace now, isn’t it? The temporary clinic.

MS. SWOPE: Yes.

MR. FUSCALDO: Where is that on this –- in relation to –-

MS. SWOPE: You go back to the –- hang on, I'll show him. Go back to the aerial photo. It is right –- right in here.

MR. FUSCALDO: Okay. All right.

CAPTAIN MAHAFFEY: That's a new building.

MS. SWOPE: Yeah.

MR. MISENHIMER: So, what we're proposing today is that the removal or cleanup that occurred in 1994 was sufficient and that no further action is required for the soils in that area, and the groundwater, again, as I said, be evaluated with an adjacent site. And that's pretty much all I was gong to say about Site 19. Are there any questions?

MR. FUSCALDO: And Site 40, what was that again?

MS. SWOPE: That's a storage lot, scrap metal.

MR. MISENHIMER: Now let’s see if I can pull it up. Okay. Site 29 is the second site we want ro talk about today. This is an area where an unlined naturalization pit received battery acid from an area about where batteries were drained. And in 1995, our remedial investigation suggested that there were human health risks, potential risks with heavy metals in the soils, so in 1997, the neutralization pit and all the soil that surrounded. that neutralization pit was removed. Here’s an aerial photo. This area in red, within this area here is where the neutralization pit was located and it’s–-

MS. SWOPE: (interjecting) It’s the corner between the heavy duty shop and the battery shop, behind it, toward the community house.

MR. MISENHIMER: And the surrounding soil, which was removed. Just south of the site is a cooling pond. The cooling pond, which is also known as Site 55, is another installation restoration site which is currently under investigation. These buildings are in the transportation area there's a lot of activity that goes on around these related to transportation, and public works.

Here's a site photo. The area that we have highlighted in red is essentially this area in here. The neutralization pit is under-ground. It was covered over some years ago and covered with asphalt paving and –- so, we had to dig that up to find the neutralization put and remove any contaminated soil that surrounded it.

MR. FUSCALDO: Now, I remember this –- I don't know how many –- how many meetings ago it was that –- when this thing was detailed.

MS. SWOPE: When we did the work?

MR. FUSCALDO: And I'm just kind of wondering how–- how that's turned out, you know, has there been any other indications of heavy metal contamination in there?

MR. MISENHIMER: Well, what we did was the area that was excavated here was an area that compassed about twenty-two feet by about thirty-eight feet. We went down seven feet. Before we got started, we had some preliminary goals in terms of what kinds of levels were acceptable for metals in the soils. So, as we went along, we sampled the soil. If we weren't meeting our goal, we dug some more out until we got to the point where we felt we were okay. After that was completed and the sampling data came back, then we looked at the human health risks. We'd run the numbers that you typically do to evaluate human health risks and based on that analysis, it was determined that the soil was fine, as well as the groundwater on this site.

MS. SWOPE: When we removed that, we removed a couple of oil separators that were old, an old oil tank.

MR. MISENHIMER: Right, right. Yes.

MS. SWOPE: There was a lot of things in the area, so we got rid of it all together.

MR. FUSCALDO: I remember it was a

real bad site.

MS. SWOPE: Right.

MR. FUSCALDO: Like most of that old stuff is.

MR. MISENHIMER: Okay. So, the contaminants that we were concerned about are listed up here; antimony, arsenic, iron, lead and mercury. So, as I said, when the soil was removed, we took samples and these were the things that we were checking on. And then, when we did the risk assessment, we did it based on these contaminants.

So, in summary, we feel that there’s no need for any further action on the soils at Site 29 and that, based on our evaluation of groundwater, there’s no need for any action with groundwater. The groundwater is fine and we believe that we’re done with this site, essentially. Yes?

MS. VAN DE WEERT: You keep saying the soils were removed. Where are they taken to?

MR. MISENHIMER: Oh, okay.

MS. VAN DE WEERT: Landfills?

MR. MISENHIMER: Yes. They’re taken off-site to a landfill.

MS. SWOPE: Actually –-

MR. FUSCALDO: (interjecting) Well, it’s an incinerator, isn’t it?

MS. SWOPE: The PCB –- the PCB soil –- this soil went to a cement kiln, brick kiln, I think. And then, the PCB soil went to one of very few PCB facilities that either landfill it or burn it, depending on the concentration of PCBs. And they verify that when they get it there. There are very few that will accept that. It went out west by train.

MR. FUSCALDO: It just doesn’t get moved somewhere else to be somebody else’s problem?

MR. MISENHIMER: No.

MS. SWOPE: Right. But the primary thing here were –- essentially, any time you’ve got petroleum type products, it ends up being burned in a brick kiln a lot of times, so you get some valuable use out of it.

MR. MISENHIMER: Any more questions? Okay. Our next site is Site 25, known as the pesticide rinse area. And this is an area where pesticide containers were rinsed outside and the containers were then –- whatever was left was spilled on the ground. And also, inside a building, there was a slop sink where containers were rinsed and this slop sink drained into a french drain. Our remedial investigation suggests there were human health and ecological concerns from pesticides and heavy metals in the soil and in the sediment.

This is an aerial photo and it shows you building 134, right here. This is the building where the slop sink was located and this is the french drain, so material would drain out here and infiltrate into the ground. The other area where the containers were rinsed was out in this area, here, and whatever was left in the container was then dumped on the ground out here. So, in our investigation, we were concerned about the french drain and any movement of any of the contaminants, the pesticides that may be present there. And then, this area, here, where we know things were dumped on the ground.

The other thing I guess I wanted to point out on this slide is that this is a drainage through here. It’s kind of an intermittent drainage way and it is –- a good portion of this has been delineated as a wetland area.

Upgrade, here, is the cooling pond, just to relate back to Site 29. Site 29 is somewhere over in this direction. The cooling ponds are over here. And this is Site 25. So, ultimately, any overland flow drains down in this direction and into the Upper Machodoc Creek.

This is a site photo. Looking towards the Potomac River and Upper Machodoc Creek over in this direction. This is part of the wetland area in here and this is monitoring well.

Now, this diagram shows what the preferred alternative is and it may be difficult to see this in the back here, but on the handout, this little handout here, it might be easier to follow. There’s a green line here that outlines the wetland area and then, this solid line, here, outlines the area where we’re proposing to excavate the contaminated soil and haul that off-site for disposal at a landfill.

There are also some hot spot areas identified. Here’s one. Here’s another one. And then, the french drain area, which would also be excavated and hauled off-site for disposal. In this case, the material that would be hauled off would go to landfill and used as a daily cover at a landfill. The levels of contaminants are not that high that it would require any treatment prior to going to a landfill.

After this area, here, is excavated, we’re talking about going down to a depth of about two feet. In some hot spot areas identified here, we might be going down as far as four –- four or five feet. This area would then be regraded to –- back to the existing area and the wetland area would be reestablished.

So, the preferred alternative is that we remove all the contaminated soil, reestablish the wetland, we're going to send the contaminated soil to an off-site landfill. And because of this, we should have a situation where no long term monitoring of the site would be necessary because we're removing all the contaminated soil.

Any questions on Site 25?

MR. FUSCALDO: I guess -- yeah, how do you -- how do you determine that you removed all the contaminated soil? That's a hard thing to do at a site like that, isn't it?

MR. MISENHIMER: Okay. That's a good question. Whenever we do any excavation like this, part of the project is to verify what you have left after you've taken this out, the soil that's left is clean. And so, a verification sampling plan is prepared and then we go ahead and take samples. So, as you're excavating this, we will typically grid this area off and then take samples at different points and based on those sampling results, we'll decide, okay, is it okay or do we need to remove some more soil.

MR. FUSCALDO: How do you work that site when it's so wet in there.

MS. SWOPE: We could it right now.

MR. FUSCALDO: Okay.

MR. MISENHIMER: That's a good point.

MR. FUSCALDO: That gives me an indication. Okay.

MR. MISENHIMER: But one of the things that we take into consideration is really the time of year in which we're trying to work. We'll try to make sure it's during a dry period. You know, there's no guarantees on that, as you well know. But apparently --

MR. FUSCALDO: (interjecting) August is supposed to be pretty wet.

MS. SWOPE: These are all proposed that we would do the work next fiscal year, so it will happen in 2000.

MR. FUSCALDO: Okay. All right.

MS. SWOPE: And the other thing is that when we remove that, we'd like to increase the wetland capacity and there and make it even more beneficial as wetland and not replace -- you know, not have to haul in clean dirt, just regrade and make it a better wetland.

MR. FUSCALDO: Good idea. Good idea.

MR. MISENHIMER: Any other questions? Okay.

MS. SWOPE: Do we want to have a formal comment period. You know, I'll take another minute for you to ask more questions that will be recorded and after that, we'll cut off the recorder. We have refreshments and you can ask us some more questions that you'd rather not be recorded.

MR. FUSCALDO: I'm personally finished.

MS. SWOPE: Okay. Patty, do you have any more questions?

MS. VAN DE WEERT: No.

MS. SWOPE: Anyone? Captain?

MR. MISENHIMER: One thing that I guess should be mentioned is that the comment period started last Wednesday.

MS. SWOPE: It was annouced in the *Free Lance.*

MR. MISENHIMER: Right. And it goes for thirty days and the comment period ends August --

MS. SWOPE: 19th.

MR. MISENHIMER: August 19th.

MS. SWOPE: So, you are welcome to submit written comments to the locations on the back anytime before August 19th. If you think of something else or you pass the information to someone who has questions, we welcome any questions or comments. Anybody else? We'll officially close the comment period then.

MEETING CONCLUDED AT 7:32 P.M.

CERTIFICATE OF COURT REPORTER

I, Lola Gail Serrett, hereby certify that I was the Court Reporter at the Public Meeting held at King George Courthouse, King George, Virginia, on July 28, 1999, at the time of the meeting herein.

I further certify that the foregoing transcript is a true and accurate record of the proceeding herein.

Given under my hand this 31st day of July, 1999.

Lola Gail Serrett

LOLA GAIL SERRETT
Court Reporter

FILE: P072899L.HRG

APPENDIX C

APPLICABLE OR REVELANT AND APPROPRIATE REQUIREMENTS

APPENDIX C

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
SITE 25 PESTICIDE RINSE AREA
NSWCDL, DAHLGREN, VIRGINIA

ARAR or TBC	Statute or Regulation	Classification	Requirement Synopsis	Applicabilty to Remedial Alternatives
I. LOCATION SPECIFIC				
Endangered Species Act of 1978 Virginia Endangered Species Regulations Rules and Regulations for the Enforcement of the Endangered Plant And Insect Species Act	16 USC § 1531 50 CFR Part 402 4 VAC 15-20-130 to 140 2 VAC 5-320-10	Applicable Applicable Applicable	Act requires federal agencies to ensure that any action authorized by an agency is not likely to jeopardize the continued existence of any endangered or threatened species or adversely affect its critical habitat. Similar Virginia requirements for submittal and review of environmental assessments.	Potentially affected endangered species have not been identified. The remedial action will be implemented so resources are not adversely affected should any be identified in the future.
The Archaeological and Historical Preservation Act of 1974 Virginia Natural Area Preserves Act	16 USC§ 469 Va. Code Ann. §§ 10.1-209 to 217	Applicable To be Considered	Requires actions to avoid potential loss or destruction of significant scientific, historical, or archaeological data. Allows for preservation of certain significant ecological systems.	Site is known to be within a historically significant area. If future resources are identified actions will be taken to ensure compliance. If specific species are found, actions will be taken to eliminate or minimize degradation to these resources.
Migration Bird Area	16 USC §703	Applicable	Protects almost all species of native birds in the U.S. from unregulated “take” which can include poisoning at hazardous waste sites.	Remedy will be implemented to ensure that wastes have no impacts to native birds.

APPENDIX C

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
SITE 25 PESTICIDE RINSE AREA
NSWCDL, DAHLGREN, VIRGINIA

ARAR or TBC	Statute or Regulation	Classification	Requirement Synopsis	Applicabilty to Remedial Alternatives
Chesapeake Bay Preservation Area Designation and Management Regulations	9 VAC 10-20-10 to 280	Relevant and Appropriate	Requires that certain locally designated tidal and non-tidal wetlands and other sensitive areas be subject to limitations regarding land-disturbing activities, removal of vegetation, use of impervious cover, erosion and sediment control, and stormwater management.	Remedy implementation will require construction activities. Actions will address the regulatory requirements.
Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities	40 CFR 264.18 (b)	Applicable	Applies to treatment, storage, or disposal of hazardous wast within a 100 year floodplain area.	Remedy implementation may produce hazardous wastes within the 100 year floodplain area. Hazardous wastes, if encountered, will be managed consistent with Federal and Virginia requirements.
Virginia Water Protection Permit Regulation	9 VAC 25-210-10 to 260	Applicable	Facility or activity design must adequately address the issues arising from locating facilities in wetlands and delineated wellhead protection areas (determined vulnerable).	Remedy implementation will impact a wetland area. The remedy will minimize impacts to the wetlands and will restore wetlands areas on the facility.
Executive Order 11988, Protection of Floodplains	40 CFR 6, Appendix A; excluding Sections 6(a)(2), 6(a)(4), 6(a)(6); 40 CFR 6.302	Applicable	Federal agencies should avoid to the extent possible adverse impacts associated with the destruction or modification of floodplains.	Site is partially in the 100 year floodplain. Remedy will be installed in the floodplain and will be designed and constructed to minimize impacts to floodplain resources.

APPENDIX C

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
SITE 25 PESTICIDE RINSE AREA
NSWCDL, DAHLGREN, VIRGINIA

ARAR or TBC	Statute or Regulation	Classification	Requirement Synopsis	Applicability to Remedial Alternatives
Executive Order 11990, Protection of Wetlands	40 CFR 6, Appendix A	Applicable	Federal agencies should avoid to the extent possible adverse impacts associated with the destruction or modification of wetlands.	Portions of the site are characterized as wetlands. Remedy implementation will be designed and constructed to restore wetland impacts.
Clean Water Act of 1972 (CWA) Section 404	33 USC §§1344			
Wetlands Mitigation Compensation Policy	4 VAC 20-390-10 to 50	Applicable	The Federal agencies should request Va. Marine Resources Commission (VMRC) determine jurisdiction of the wetlands and applicable regulatory requirements.	The Navy will contact the VMRC concerning this project.

APPENDIX C

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
SITE 25 PESTICIDE RINSE AREA
NSWCDL, DAHLGREN, VIRGINIA

ARAR or TBC	Statute or Regulation	Classification	Requirement Synopsis	Applicability to Remedial Alternatives
II. ACTION SPECIFIC				
Virginia Solid Waste Management Regulations	9 VAC 20-80-10 to 790	Applicable	Prescribes the requirements for cleanup and corrective action for remediation of releases that have occurred as the result of improper management of solid wastes.	Solid wastes at Site 25, shall be handled under these regulations.
	Part IV. Management of Open Dumps and Unpermitted Facilities	Applicable	Requires the remedy to alleviate the conditions that may cause the facility to be classified as an open dump.	

APPENDIX C

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
SITE 25 PESTICIDE RINSE AREA
NSWCDL, DAHLGREN, VIRGINIA

ARAR or TBC	Statute or Regulation	Classification	Requirement Synopsis	Applicability to Remedial Alternatives
Virginia Hazardous Waste Management Regulations	9 VAC 20-60-12 to 1505	Applicable	Applies to treatment, storage, or disposal of hazardous waste.	Hazardous wastes encountered will be managed consistent with Federal and Virginia requirements.
	9 VAC 20-60-261	Applicable	Provides that certain hazardous waste remaining in “empty” containers are not regulated as hazardous waste.	Rinseate from empty non-acutely toxic pesticide (such as DDT) containers are exempt.
EPA’s Area of Contamination (AOC) Policy	Policy	To Be Considered	Allows hazardous waste to be managed within discrete areas without triggering hazardous waste regulatory requirements.	Waste generated on-site may be stored temporarily on-site prior to off-site disposal.
EPA’s Contained-in Policy	Policy	To Be Considered	Allows the choice of appropriate health-based levels (for dieldrin) above which contaminated media must be handled as if it were a hazardous waste.	Contaminated soils at Site 25 do not contain listed hazardous waste and therefore are not automatically subject to LDRs. This policy applies to contaminated soils containing dieldrin.
Regulations Governing the Transportation of Hazardous Materials	9 VAC 20-110-10 to 130	Applicable	Applies to transportation of hazardous waste.	Hazardous wastes, if encountered, will be managed consistent with Federal and Virginia requirements.

APPENDIX C

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
SITE 25 PESTICIDE RINSE AREA
NSWCDL, DAHLGREN, VIRGINIA

ARAR or TBC	Statute or Regulation	Classification	Requirement Synopsis	Applicability to Remedial Alternatives
Military Munitions Rules	(40 CFR 260-266 and 270)	To Be Considered	Recently promulgated regulations in response to Section 107 of the Federal Facilities Compliance Act of 1992, identifying when conventional and chemical military munitions become hazardous waste. Applications of the rules are a 'TBC' until adopted by states authorized to administer RCRA.	Ordnance-related wastes potentially buried at Site 25 will be managed in compliance with the rules.
DoD Guidance on Property Contaminated with Ammunition, Explosives or Chemical Agents	DoD 6055.9-STD	To Be Considered	Dod guidance document stipulating policy and procedure to provide protection of personnel resulting from DoD ammunition, explosives or chemical agent contamination. Includes property currently or formerly owned, leased or used by DoD, and calls for identification and control at active installations, and provides guidance for potential land disposal.	Excavation of Site 25 will be completed to be consistent with DoD policy and procedures to address safety issues should UXO issues arise.
Erosion and Sediment Control Regulations	4 VAC 50-30-10 to 110	Applicable	Erosion and sediment control plans are to be submitted for land-disturbing activities, and be in compliance with of the locality and/or local soil and water conservation district.	Construction activities will disturb the land in the vicinity of the site. Activities will address Virginia erosion and sediment control requirements.

APPENDIX C

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
SITE 25 PESTICIDE RINSE AREA
NSWCDL, DAHLGREN, VIRGINIA

ARAR or TBC	Statute or Regulation	Classification	Requirement Synopsis	Applicability to Remedial Alternatives
AIR				
Ambient Air Quality Standards	9 VAC 5-30-10 to 80			
Visible and Fugitive Dust Emissions	9 VAC 5-30-20	Applicable	Control of Particulate Matter (TSP)	Visible and Fugitive Dust emissions from remedial actions shall be controlled, as necessary.
	9 VAC 5-30-60	Applicable	Control of Particulate Matter (PM10)	
	9 VAC 5-50-60 to 120	Applicable	Standards for visible and/or fugitive dust emissions.	
Standards of Performance for Toxic Pollutants	9 VAC 5-50-160 to 230	Applicable	Standards of performance for toxic pollutants.	Toxic pollutants are not expected during remedial actions; however, corrective action will be performed if problems arise.
WATER				
Criteria for Classification of Solid Waste Disposal Facilities and Practices	49 CFR 257.3-3(a) 33 USC §§1288 & 1342	Potentially Applicable	A facility shall not cause a discharge of pollutants into the waters of the U.S. that is in violation of the substantive requirements of the NPDES under CWA Section 402, as amended	No discharges under the remedy are planned. In addition, NPDES program is delegated to Virginia (VPDES). Potentially applicable for situations potentially not covered by VPDES.
Water Quality Standards	9 VAC 25-260-5 to 550	Applicable	Standards and criteria for State waters, including wetlands.	Provides standards for evaluating State waters and wetlands at Site 25.

APPENDIX C

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
SITE 25 PESTICIDE RINSE AREA
NSWCDL, DAHLGREN, VIRGINIA

ARAR or TBC	Statute or Regulation	Classification	Requirement Synopsis	Applicability to Remedial Alternatives
Virginia Pollutant Discharge Elimination System (VPDES)	9 VAC 25-31-10 to 940	Applicable	Procedures and requirements for discharging pollutants into surface waters, or any activity which impacts physical, chemical or biological properties of surface waters.	Excavation, backfilling and regrading Site 25 not expected to produce waste liquids that would be discharged to surface waters.
Virginia Pollution Abatement (VPA) Permit Regulation	9 VAC 25-32-10 to 300	Applicable		
Stormwater Management Regulations	4 VAC 3-20-10 to 251	Applicable	Criteria for Stormwater Management.	Excavation, backfilling, and regrading of Site 25 will include applicable stormwater management requirements.

APPENDIX D

CALCULATION WORKSHEETS

APPENDIX D

CALCULATION WORKSHEET

CLIENT: DAHLGREN, SITE 25		JOB NUMBER: 0291	
SUBJECT: CALCULATION OF SOIL HEALTH-BASED LEVELS FOR THE CONSTRUCTION WORKER SCENARIO			
BASED ON: USEPA, DEC. 1989			
BY: T. Jackman	CHECKED BY: AM 09/10/99		DATE: August 30, 1999

PURPOSE: To calculate soil health-based levels for dieldrin that will be protective of future construction worker exposures for the reasonable maximum exposure (RME) scenario. This scenario includes workers involved in the excavation, transportation and management of disposal of soil at these levels.

METHODOLOGY: Since risk assessment equations are linear for soil exposures, an acceptable soil concentration can be calculated by a ratio of the soil concentration and the resulting risk determined in the risk assessment for Site 25 with a target cancer risk (TCR) or target hazard index (THI). For Site 25, the TCR is 1.0E-4 and the THI is unity (1). The soil health-based level was calculated by the following equation.

$$SRG = \frac{Cs \ x \ TCR \ or \ THI}{Risk_{25}}$$

Where

SRG = Soil Remediation Goal or Health-Based Limit (mg/kg)
Cs = soil concentration used in the Site 25 risk assessment (mg/kg)
TCR = Target Cancer Risk
THI = Target hazard Index
$Risk_{25}$ = Soil risk calcualted in the Site 25 Risk Assessment

<u>Calcuation of Soil Remediation Goal for Dieldrin - Noncarcinogenic Effects</u>

Cs = 48 mb/kg
THI = 1
$Risk_{25}$ = 4.51(ingestion) + 4.32 (Dermal) = 8.83

$$SRG = \frac{48 \ x \ 1}{8.83}$$

SRG (Dieldrin) = 5.4 mg/kg

CLIENT: DAHLGREN, SITE 25		JOB NUMBER: 0291	
SUBJECT: CALCULATION OF SOIL HEALTH-BASED LEVELS FOR THE CONSTRUCTION WORKER SCENARIO			
BASED ON: USEPA, DEC. 1989			
BY: T. Jackman	CHECKED BY: JM 09/10/99		DATE: August 30, 1999

Calculation of Soil Health-Based Levelfro Dir\eldrin- Carcinogenic Effects

Cs = 48 mg/kg
TCR = 1.0E-4
$Risk_{25}$ = 5E-5 (Ingestion) + 5.2E-5 (Dermal) = 1.0E-4

$$SRG = \frac{48 \text{ x } 1.0E-4}{1.0E-4}$$

SRG (Dieldrin) = 48 mg/kg

Since the health-basd level calcualted for noncarcinogenc effects is lower, i.e., more conservative, this value, 5.4 mg/kg, is the level chosen for construction worker exposure to dieldrin.

APPENDIX E

TOXICITY PROFILES

TOXICITY PROFILES – DAHLGREN, SITE 25

ALDRIN AND DIELDRIN

Aldrin and dieldrin mainly affect the central nervous system. Accidental or intentional ingestion of high levels of aldrin and dieldrin result in convulsions and death. Ingesting moderate levels of aldrin or dieldrin over a longer period may also cause convulsions. This occurs because aldrin and dieldrin build up in our bodies.

The effects of exposure to low levels of aldrin or dieldrin over a long time are not known. Some workers who made or applied the insecticides had nervous system effects with excitation leading to convulsions. Lesser effects in some workers included headaches, dizziness, vomiting, irritability, and uncontrolled muscle movements. Workers removed from the source of exposure rapidly recovered from most of these effects. Studies in animals indicate that aldrin or dieldrin may reduce the body's ability to resist infection.

The International Agency for Research on Cancer has determined that aldrin and dieldrin are not classifiable as to their carcinogenicity to humans. There is no direct evidence that aldrin or dieldrin causes cancer in humans. Studies on workersgenerally show no increase in cancer or deaths due to cancer. Mice given high amounts of dieldrin, however, did develop liver cancers. Aldrin and dieldrin are classified as Class B2 carcinogens by the EPA.

ALUMINUM

Aluminum is not generally regarded as an industrial poison. Inhalation of finely divided powder has been reported as a cause of pulmonary fibrosis. Aluminum in aerosols has been implicated in Alzheimer's disease. As with other metals, the powder and dust are the most dangerous forms. Most hazardous exposures to aluminum occur in refining and smelting processes. Aluminum dust is a respiratory and eye irritant The EPA has published an oral RfD of 1.00 mg/kg/day (IRIS) and an inhalation reference dose of 0.001 mg/kg/day (HEAST, 1997) for aluminum.

ANTIMONY

Ingested antimony is absorbed slowly and incompletely from the gastrointestinal (GI) tract Within a few days of acute exposure, highest tissue concentrations are found in the liver, kidney, and thyroid. Organs of storage include skin. bone, and teeth. Highest concentrations in deceased smelter workers (inhalation exposure) occurred in the lungs and skeleton.

Acute intoxication from ingestion of large doses of antimony induces GI disturbances, dehydration, and cardiac effects in humans. Chronic effects from occupational exposure include irritation of the respiratory tract, pneumoconiosis, pustular eruptions of the skin called "antimony spots," allergic contact dermatitis, and cardiac effects, including abnormalities of the electrocardiograph (ECG) and myocardial changes. Cardiac effects were also observed in rats and rabbits exposed by inhalation for six weeks and in animals (dogs, and possibly other species) treated by intravenous injection.

Chronic oral exposure resulted in reduced longevity in both species and in reduced mean heart weight in the rats. The EPA verified an RfD of 0.0004 mg/kg/day for chronic oral exposure to antimony from the LOAEL of 5 ppm potassium antimony tartrate (0.35 mg antimony/kg body weight-day) in the lifetime study in rats. The heart is considered a likely target organ for chronic oral exposure of humans.

Antimony is classified in EPA cancer weight-of-evidence Group D (not classifiable as to carcinogenicity to humans).

ARSENIC

The toxicity of inorganic arsenic (As) depends on its valence state (-3, +3, or +5), and also on the physical and chemical properties of the compound in which it occurs. Trivalent (As+3) compounds are generally more toxic than pentavalent (As+5) compounds, and the more water soluble compounds are usually more toxic and more likely to have systemic effects than the less soluble compounds, which are more likely to cause chronic pulmonary effects if inhaled.

The Reference Dose for chronic oral exposures, 0.0003 mg/kg/day, is based on a NOAEL of 0.0008 mg/kg/day and a LOAEL of 0.014 mg/kg/day for hyperpigmentation, keratosis, and possible vascular complications in a human population consuming arsenic-contaminated drinking water. Bemuse of uncertainties in the data, U.S. EPA states that "strong scientific arguments can be made for various values within a factor of 2 or 3 of the currently recommended RfD value." The subchronic Reference Dose is the same as the chronic RfD, 0.0003 mg/kg/day.

Epidemiological studies have revealed an association between arsenic concentrations in drinking water and increased incidences of skin cancers (including squamous cell carcinomas and multiple basal cell Carcinomas), as well as cancers of the liver, bladder, respiratory and gastrointestinal tracts. Occupational exposure studies have shown a clear correlation between exposure to arsenic and lung cancer mortality. U.S. EPA has placed inorganic arsenic in weight-of-evidence group A. human carcinogen.

BARIUM

The soluble salts of barium, an alkaline earth metal, are toxic in mammalian systems. They are absorbed rapidly from the gastrointestinal tract and are deposited in the muscles, lungs, and bone. Barium is excreted primarily in the feces. At low doses, barium acts as a muscle stimulant and at higher doses affects the nervous system eventually leading to paralysis. Acute and subchronic oral doses of barium cause vomiting and diarrhea, followed by decreased heart rate and elevated blood pressure. Higher doses result in cardiac irregularities, weakness, tremors, anxiety, and dyspnea.

Subchronic and chronic oral or inhalation exposure primarily affects the cardiovascular system resulting in elevated blood pressure. Human data were used by the EPA to calculate a chronic and subchronic oral reference dose (RfD) of 0.07 mg/kg/day. Subchronic and chronic inhalation exposure of human populations to barium-containing dust can result in a benign pneumoconiosis called "baritosis." This condition is often accompanied by an elevated blood pressure but does not result in a change in pulmonary function. However. Reproductive and developmental effects and increased fetal mortality in rats were also observed after inhalation exposures. An inhalation reference concentration (RfC) of 0.005 Mg/M^3 for subchronic and 0.0005 mg/m^3 for chronic exposure was calculated by the EPA based on the NOAEL for developmental effects which have not been substantiated in humans.

BENZO[A]PYRENE (BAP)

In the risk assessment for Site 25, PAHs are evaluated as benzo(a)pyrene equivalents, where:

Benz[a]anthracene = 0.1 BAP
Benzo[b]fluoranthene = 0.1 BAP
Dibenz[a,h]anthracene = BAP

Benzo (a)pyrene is readily absorbed across the GI and respiratory epithelia. Benzo (a)pyrene was distributed widely in the tissues of treated rats and mice, but primarily to tissues high in fat such as adipose tissue and mammary gland.

PAHs are ubiquitous, being released to the environment from anthropogenic as well as from natural sources, Benzo(a)pyrene is the most extensively studied member of the class, inducing tumors in multiple tissues of virtually all laboratory species tested by all routes of exposure.

Because of the lack of human cancer data, assignment of individual PAHs to EPA cancer weight-of-evidence groups was based largely on the results of animal studies with large doses of purified compound. Benzo (a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene were classified in Group B2 (probable human carcinogens).

The EPA (1998) verified a slope factor for oral exposure to benzo(a)pyrene of 7.3 per mg/kg/day, based on several dietary studies in mice and rats. Neither verified nor provisional quantitative risk estimates were available for the other PAHs in Group B2. Largely because of this precedent, the quantitative risk estimates for benzo(a)pyrene were adopted for the other carcinogenic PAHs when quantitative estimates were needed.

Human data specifically linking benzo[a]pyrene (BAP) to a carcinogenic effect are lacking. There are, however, multiple animal studies in many species demonstrating BAP to be carcinogenic following administration by numerous routes. In addition, BAP has produced positive results in numerous genotoxicity assays.

The data for animal carcinogenicity was sufficient The animal data consist of dietary, gavage, inhalation, intratracheal instillation, dermal and subcutaneous studies in numerous strains of at least four species of rodents and several primates. Repeated BAP administration has been associated with increased incidences of total tumors and of tumors at the site of exposure. Benzo [a]pyrene has been shown to cause genotoxic effects in a broad range of prokaryotic and mammalian cell assay systems.

The EPA publishes a slope factor for oral exposure to benzo(a)pyrene of 7.3 per mg/kg/day, based on several dietary studies in mice and rats. Neither verified nor provisional quantitative risk estimates are available for the other PAHs. Largely because of this precedent the quantitative risk estimates for benzo(a)pyrene were adopted for the other carcinogenic PAHs when quantitative estimates were needed.

BIS(2-ETHYLHEXYL)PHTHALATE

Bis(2-ethylhexyl)phthalate is a colorless oily liquid that is extensively used as a plasticizer in a wide variety of industrial, domestic and medical products. It is an environmental contaminant and has been detected in ground water, surface water, drinking water, air, soil, plants, fish and animals. It is rapidly absorbed from the gastrointestinal tract primarily and can be absorbed through the skin and from the lungs.

Animal studies have indicated that the primary target organs are the liver and kidneys. However, higher doses are reported to result in testicular effects and decreased hemoglobin and packed cell volume. Studies on occupational exposures to mixtures of phthalate esters containing bis(2ethylhexyl)phthalate have reported sensory-motor effects and decreased leukocytes and hemoglobin in some exposed workers. Developmental toxicity studies with rats and mice have shown that bis(2-ethylhexyl)phthalate is fetotoxic and teratogenicwhen given orally during gestation. Oral exposure has also been shown to result in decreased sperm count in rats. A Reference Dose (RfD) for both subchronic and chronic oral exposure was calculated from a lowest-observed-adverse-effect level (LOAEL) based on increased relative liver weight in guinea pigs.

Bis(2-ethylhexyl)phthalate was assigned to weight-of-evidence Group B2, probable human carcinogen, on the basis of an increased incidence of liver tumors in rats and mice.

CHROMIUM

In nature, chromium (III) predominates over chromium (VI). Little chromium (VI) exists in biological materials, except shortly after exposure, because reduction to chromium (III) occurs rapidly. Chromium (III) is considered a nutritionally essential traceelement and is considerably less toxic than chromium (VI).

Acute oral exposure of humans to high doses of chromium (VI) induced neurological effects, GI hemorrhage and fluid loss, and kidney and liver effects. An NOAEL of 2.5 mg chromium (VI) /kg/day in a one-year drinking water study in rats and an uncertainty factor of 300 was the basis of a verified RfD of 0.003 mg/kg/day for chronic oral exposure. An NOAEL (No effects were observed in rats consuming 5% chromium (III)/kg/day in the diet for over two years) of 1,468 mg/kg-day for chromium (III) and an uncertainty factor of 100 was the basis of the RfD of 1.5 mg/kg/day for chronic oral exposure.

Occupational (inhalation and dermal) exposure to chromium (III) compounds induced dermatitis. Similar exposure to chromium (VI) induced ulcerative and allergic contact dermatitis, irritation of the upper respiratory tract including ulceration of the mucosa and perforation of the nasal septum, and possibly kidney effects,

A target organ was not identified for chromium (III). The kidney appears to be the principal target organ for repeated oral dosing with chromium (VI). Additional target organs for dermal and inhalation exposure include the skin and respiratory tract

DDT, DDE, and DDD

DDT affects the nervous system. People who accidentally swallowed large amounts of DDT became excitable and had tremors and seizures. These effects went away after the exposure stopped. No effects were seen in people who took small daily doses of DDT by capsule for 18 months. People who worked with DDT for a long time had some reversible changes in the levels of liver enzymes.

In animals, short-term exposure to large amounts of DDT in food affected the nervous system. In animals, long-term exposure to DDT affected the liver. Animal studies suggest that short-term exposure to DDT in food may have a harmful effect on reproduction.

The Department of Health and Human Services (DHHS) has determined that DDT may reasonably be anticipated to be a human carcinogen. DHHS has not classified DDE and DDD, but the Environmental Protection Agency (EPA) has determined that they are probable human carcinogens. Liver cancer has been seen in animals that were fed DDT. Studies in DDT-exposed workers did not show increases in cancer.

DIELDRIN

Dieldrin is an insecticide which from 1950-1970 was a popular pesticide for crops like oorn and cotton. Because of concerns about damage to the environment and the potential harm to human health, EPA banned all uses of dieldrin in 1974 except to control termites. In 1987, EPA banned all uses. Exposure to dieldrin happens mostly from eating contaminated foods, such as root crops, fish, or seafood. Dieldrin build up in the body after years of exposure and can damage the nervous system.

Exposure to dieldrin mainly affect the central nervous system. Ingestion of high levels of dieldrin result in convulsions and death. These levels are many thousands of times higher than the average exposure. Ingesting rnoderate levels of dieldrin over a longer period may also cause convulsions. We don't know the effects of exposure to lowlevels of dieldrin over a long time. Some workers who made or applied dieldrin had nervous system effects with excitation leading to convulsions. Lesser effects in some workers included headaches, dizziness, vomiting, irritability, and uncontrolled muscle movements. Workers removed from the source of exposure rapidly recovered from most of these effects. The EPA had established an oral RfD of 5E-5 mg/kg-day for dieldrin based on liver lesions in rats from a 2-year study.

There is no direct evidence that dieldrin causes cancer in humans. Studies on workers generally show no increase in cancer or deaths due to cancer. Mice given high amounts of dieldrin, however, did develop liver cancers. Dieldrin has been classified as a probable human carcinogen (B2) by the EPA because it caused tumors in rodents when administered orally.

CHLORINATED DIBENZO-P-DIOXINS (CDDS)

The most noted health effect in people exposed to large amounts of 2,3,7,8-TCCD is chloracne. Chloracne is a severe skin disease with acne-like lesions that occur mainly on the face and upper body. Changes in blood and urine that may indicate liver damage also are seen in people. Exposure to high concentrations of CDDs may induce long-term alterations in glucose metabolism and subtle changes in hormonal levels.

Exposure to lower levels can cause a variety of effects in animals, such as weight loss, liver damage, and disruption of the endocrine system. In many species of animals, 2,3,7,8-TCDD weakens the immune system and causes a decrease in the system's ability to fight bacteria and viruses. In other animal studies, exposure to 2,3,7,8-TCDD has caused reproductive damage and birth defects, Some animal species exposed to CDDs during pregnancy had miscarriages and the offspring of animals exposed to 2,3,7,8-TCCD during pregnancy often had severe birth defects including skeletal deformities, kidney defects, and weakened immune responses.

Several studies suggest that exposure to 2.3,7,8-TCDD increases the risk of several types of cancer in people. Animal studies have also shown an increased risk of cancer from exposure to 2,3,7,8-TCDD. The EPA and the World Health Organization (WHO) has determined that 2.3.7,8TCDD is a human carcinogen.

ENDRIN

Endrin is a solid, white, almost odorless substance that was used as a pesticide to control insects, rodents, and birds. Endrin has not been produced or sold for general use in the United States since 1986. Little is known about the properties of endrin aldehyde (an impurity and breakdown product of endrin) or endrin ketone (a product of endrin when it is exposed to light).

Endrin does not dissolve very well in water. It has been found in groundwater and surface water, but only at very low levels. It is more likely to cling to the bottom sediments of rivers, lakes, and other bodies of water. The persistence of endrin in the environment depends highly on local conditions. Some estimates indicate that endrin can stay in soil for over 10 years.

Exposure to endrin can cause various harmful effects including death and severe central nervous system (brain and spinal cord) injury. Swallowing large amounts of endrin may cause convulsions and kill you in a few minutes or hours. Symptoms that may result from endrin poisoning are headaches, dizziness, nervousness, confusion, nausea, vomiting, and convulsions. No long-term health effects have been noted in workers who have been exposed to endrin by breathing or touching it. Studies in animals confirm that endrin's main target is the nervous system. Birth defects, especially abnormal bone formation, have been seen in some animal studies.

In studies using rats, mice, and dogs, endrin did not produce cancer. However, most of these studies did not accurately evaluate the ability of endrin to cause cancer. No significant excess of cancer has been found in exposed factory workers. The EPA has determined that endrin is not classifiable as to its human carcinogenicity because there is not enough information to allow classification.

HEPTACHLOR AND HEPTACHLOR EPOXIDE

Heptachlor is a manufactured chemical and doesn't occur naturally. Pure heptachlor is a white powder that smells like camphor (mothballs). The less pure grade is tan. Heptachlor was used extensively in the past for killing insects in homes, buildings, and on food crops, especially corn. Use slowed in the 1970s and stopped in 1988. Heptachlor epoxide is also a white powder and is a breakdown product of heptachlor. The epoxide is more likely to be found in the environment than heptachlor. Heptachlor doesn't dissolve easily in water, heptachlor epoxide dissolves more easily. They stick strongly to soil particles and evaporate slowly to air. Heptachlor epoxide can stay in the soil and water for many years.

Heptachlor and heptachlor epoxide are toxic to humans and animals and can damage the nervous system. There are some human data on brief exposures to high levels. A few human case reports showed that people who accidentally swallowed pesticide that contained heptachlor, or who spilled pesticide on their clothes became dizzy, confused, or had convulsions.

Very high levels for short periods produce serious liver problems. Mice had trouble walking and rats developed tremors. High levels of heptachlor in the feed for several weeks damaged the livers of rats and the livers and adrenal glands of mice. Animals that ate food containing heptachlor before and/or during pregnancy had smaller litters or were unable to reproduce. Some of the offspring had cataracts and some didn't live long after birth.

The EPA has classified heptachlor expoxide asa Class B2, probable human carcinogen, on the basis of rodent studies in which liver carcinomas were induced in two strains of mice and in female rats.

alpha-HEXACHLOROCYCLOHEXANE (alpha-HCH)

Alpha-HCL has been classified as a B2, probable human carcinogen, by the EPA based on an increased incidence of liver tumors in mice and rats. There is inadequate evidence of alpha-HCH causing cancer in humans.

In animals, dietary alpha-HCH has been shown to cause increased incidences of liver tumors in five mouse strains and in Wistar rats. No date on the genetic toxicology of alpha-HCH are available. The oral slope factor (CSF for alpha-HCH is 6.3E+O (mg/kg-day)$^{-1}$ and the inhalation unit risk is 1.8E-3 (ug/m^3)$^{-1}$

beta-HEXACHLOROCYCLOHEXANE (beta-HCH)

Alpha-HCH has been classified as a C; possible human carcinogen by the EPA based on an increased incidence of liver tumors in mice. There is inadequate evidence of alpha-HCH causing cancer in humans.

Positive or marginally positive tumorigenic responses, characterized as benign hepatornas or hepatocellular carcinomas, have been observed in two strains ofmice. The studies are limited in that small numbers of animals were used.

No data on the genetic toxicology of alpha-HCH are available. The oral slope factor (CSF for alpha-HCH is l.8E+0 (mg/kg-day^3)$^{-1}$ and the inhalation unit risk is 5.3E-4 (ug/m^3)$^{-1}$.

IRON

No toxicity information is available for iron. The RfD for iron (0.3 mg/kg/day) is based on allowable intakes rather than adverse effect levels.

MANGANESE

Manganese is an essential trace element in humans that can elicit a variety of serious toxic responses upon prolonged exposure to elevated concentrations either orally or by inhalation. The central nervous system is the primary target. Initial symptoms are headache, insomnia, disorientation, anxiety, lethargy, and memory loss. These symptoms progress with continued exposure and eventually include motor disturbances, tremors, and difficulty in walking, symptoms similar to those seen with Parkinsonism. These motor difficulties are often irreversible.

Effects on reproduction (decreased fertility, impotence) have been observed in humans with inhalation exposure and in animals with oral exposure at the same or similar doses that initiate the central nervous system effects. An increased incidence of coughs, colds, dyspnea during exercise, bronchitis, and altered lung ventilatory parameters have also been seen in humans and animals with inhalation exposure.

A chronic and subchronic RfD for drinking water has been calculated by EPA from a human no observed adverse-effect level (NOAEL). The NOAEL was determined from an epidemiological study of human populations exposed for a lifetime to manganese concentrations in drinking water ranging from 3.6-2300 µg/L. A chronic and subchronic RfD for dietary exposure has been calculated by EPA from a human NOAEL which was determined from a series of epidemiological studies. A reference concentration (RfC) for chronic inhalation exposure was calculated from a human LOAEL for impairment of neurobehavioral function from an epidemiological study.

MERCURY

Toxicity resulting from subchronic and chronic exposure to mercury and mercury compounds usually involves the kidneys and/or nervous system. The specific target and effect being dependent on the form of mercury.

A subchronic and chronic oral RfD of 0.0001 mg/kg/day for methyl mercury is based an neurologic developmental abnormalities in human infants. A subchronic and chronic oral RfD of 0.0003 mg/kg/day for mercuric chloride is based on immunologic glomerulonephritis. A Lowest Observed Adverse Effect Level (LOAEL) of 0.63 mg Hg/kg/day for mercuric chloride was identified. A subchronic and chronic inhalation RfC of 0.0003 mg Hg/m^3 for inorganic mercury is based on neurological disorders.

No data were available regarding the carcinogenicity of mercury in humans or animals. EPA has placed inorganic mercury in weight-of-evidence c4assification D, not classifiable as to human carcinogenicity.

NICKEL

Nickel is a naturally occurring element that may exist in various mineral forms. It is used in a wide variety of applications including metallurgical processes and electrical components, such as batteriesSome evidence suggests that nickel may be an essential trace element for mammals. The absorption of nickel is dependent on its physicochemical form, with watersoluble forms being more readily absorbed. Toxic effects of oral exposure to nickel usually involve the kidneyswith some evidence from animal studies showing a possible developmental/reproductive toxicity effect.

Inhalation exposure to some nickel compounds will cause toxic effects in the respiratory tract and immune system. Inhalation LC50 values for animals range from 0.97 mg nickel/m3 for rats (6-hour exposure) to 15 mg nickel/m3 for guinea pigs (time not specified). Acute inhalation exposure of humans to nickel may produce headache, nausea, respiratory disorders, and death, Asthmatic conditions have also been documented for inhalation exposure to nickel. Soluble nickel compounds tend to be more toxic than insoluble compounds, No clinical evidence of developmental or reproductive toxicity were reported for women working in a nickel refinery, but possible reproductive and developmental effects in humans of occupational exposure to nickel (0.13-0.2 mg nickel/m3) have been reported. Furthermore, sensitivity reactions to nickel are well documented and usually involve contact dermatitis reactions resulting from contact with nickel-containing items such as cooking utensils, jewelry, coins, etc.

A chronic and subchronic oral reference dose (RfD) of 0.02 mg/kg/day for soluble nickel salts is based on changes in organ and body weights of rats receiving dietary nickel sulfate hexahydrate (5 mg/kg/day) for 2 years. The primary target organs for nickel-induced systemic toxicity are the lungs and upper respiratory tract for inhalation exposure and the kidneys for oral exposure. Other target organs include the cardiovascular system, immune system, and the blood.